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[OFFICIAL NOTICE.]

Fifteenth Annual Meeting, Western Gas Association.

SECRETARY'S OFFICE, WESTERN GAS ASSOCIATION,
QUINCY, ILLS., May 2d, 1892.

The Fifteenth Annual Meeting of the Western Gas Association will be held at Detroit, Mich., on the 18th, 19th and 20th days of May. The Russell House has been designated by the Committee of Arrangements as the headquarters of the Association, while the business sessions will be conducted in the Armory of the Detroit Light Infantry, two blocks distant from the Russell House. As an unusually large number of rooms has already been engaged, and the attendance promises to be unprecedentedly great, it behooves all those who have not yet done so to write for quarters without further delay. While there is no reason for fearing that we shall suffer from the discomforts caused by an overcrowded hotel, the reservation of rooms will tend to insure the greater comfort of our members by enabling Landlord Chittenden to perfect his arrangements and complete his assignments before the rush sets in.

The paper list for the Detroit meeting is as follows:

"Origin of Coal and Petroleum," by Mr. A. E. Forstall, Newark, N. J.

"New Features in the Routine Office Work of Small Gas Companies," by Mr. Walter Lee Brown, Evanston, Ills.

"Every Day Gas Analysis," by Mr. Wm. A. Stedman, Jr., St. Louis, Mo.

"The Advantages of Recuperative Furnaces in the Utilization of Heat," by Mr. Fred. Bredel, Milwaukee, Wis.

"Petroleum Products—Hydrocarbon Employed in Gas Manufacture," by Mr. C. M. Higgins, New York, N. Y.

"Fuel Gas as Viewed Through a Coal Gas Man's Spectacles," by Mr. K. M. Mitchell, St. Joseph, Mo.

"Practical Photometry Simplified for Daily Use," by Mr. B. E. Chollar, St. Louis, Mo.

"The Construction and Operation of Half-Depth Regenerative Furnaces for Firing with Cheap Coal," by Mr. W. H. Odiorne, Springfield, Ills.

All of the foregoing papers are in type and should be ready for distribution within a few days. Copies will be mailed to those who desire to look them over in advance of the date of the meeting if the Secretary is advised by letter or postal of the names to which they should be addressed. A free and thorough discussion is invited by the authors, and will add greatly to the interest and value of the meeting.

The Question-Box is already assuming plethoric proportions, as is evidenced by its present contents, which are as follows:

"What experience has been had in the spontaneous combustion of coal, and what is the best remedy for prevention?"

"Does it pay to dispense with stop-cocks and boxes on service pipes?"

"In revivifying oxide in the 'off' box without removal, is it best to use steam where it will come into contact with the material, or blow air through without steam?"

"After revivifying oxide, why is water thrown on it before replacing in the box?"

"In making water gas by the cupola system, can 30-candle gas be made as economically as 20?"

"In carbureting gas with oil burned in the retorts, how can the oil supply be regulated to the heats so as to produce the best results?"

"In using iron oxide for purification, the material is found to be charged with naphthaline. How can this be removed?"

"Are there any successful methods for removing the iron from the spent oxide?"

"Are gas companies that own and operate electric light plants satisfied with the profits they are making in this branch of their business?"

"What should be the minimum cost per 1,000 cubic feet for purification of water gas? A factor to be considered is the amount of output, and the charges should include cost of materials—lime, sawdust, shavings or chips, copperas, sal-ammoniac, iron filings, borings, etc., freight and hauling of materials, labor of preparing the oxide and lime, and all subsequent labor in both the purifying and revivifying rooms."

"Is it possible to ignite an explosive mixture of gas and air from a lighted pipe or cigar, without the aid of a flame? Is there on record an instance of this kind?"

"In the manufacture of water gas, which is the cheaper material, crude oil at 2 cents per gallon or gas naphtha at 4 cents?"

"What combustible gas would, if used alone, produce the best results in firing retorts?"

"What has caused the depreciation in the price of coal tar, and how can a good price be best maintained?"

It is to be hoped that, when the time arrives, those who can enlighten the querists with regard to the foregoing points will be so good as to impart the desired information.

Your Secretary expected to be able to announce in this issue that the various Passenger Associations had granted the usual concession of one and one-third fares to Detroit and return; but the matter is still pending, and a decision may not be rendered for several days. Of one thing our members can rest assured, and that is that everything possible is being done to secure the reduction. Moreover, if the rate is granted, no time will be lost in mailing to all our members and to those who have

made application for membership, the necessary certificates together with the instructions as to how to proceed to secure the reduced fare. Should those interested fail to receive the certificates in question, they will understand that it is simply because the reduction has not been granted.

In accordance with the provisions of Article VII., Section 1, of our by-laws, a meeting of our Board of Directors will be held at the Russell House, on the day preceding the annual meeting of the Association. The Board will therefore convene on Tuesday, May 17, at the hour of 10 A.M., and all of its members are urgently requested to be present. The following is the present composition of the Board :

E. G. Cowdery, Milwaukee, Wis.	I. C. Baxter, Detroit, Mich.
E. H. Jenkins, Columbus, Ga.	Jerome Penn, Washington, O.
W. H. Odiorne, Springfield, Ill.	A. H. Barret, Louisville, Ky.
B. E. Chollar, St. Louis, Mo.	I. S. Post, Chattanooga, Tenn.
A. W. Littleton, Quincy, Ills.	Wm. Wallace, Lafayette, Ind.
K. M. Mitchell, St. Joseph, Mo.	A. S. Miller, Omaha, Neb.
W. J. Johnston, Fort Smith, Ark.	

The list of appointees for the various standing and special committees has been prepared by President Cowdery, but will not be announced until the morning of the first day's session, lest revision might be necessary on account of the absence of some who have been designated for said committee work.

We have heretofore been honored on the occasion of each annual reunion by the presence of a goodly number of visiting brethren from the East. These gentlemen, as they may have discovered ere this, are always welcome, and we trust that they will not only take another pull at the Western's latch-string when we assemble in the lovely City of the Straits, but that they will bring with them many others of the same gracious type of (gas) manhood as themselves. While our Association is "Western" in its name, it is too broad gauged and cosmopolitan in its nature to wish to withhold from others of our fraternity their full share of the pleasure and profit which is to be enjoyed from the 18th to to the 20th days of May, inclusive. From that proud but by no means austere parent, the New England Association, to the young and promising scion, the Southwestern, we extend you one and all, individually and collectively, a hearty greeting. We bid you welcome, gentlemen, and ask you to accept our cordial invitation herewith extended.

A. W. LITTLETON, Secretary.

THE FAIR FUND.

Some advance was made during the past week in the matter of securing the funds necessary for the construction and equipment of the proposed gas building and exhibit at the World's Fair; but the Council had hoped for even greater progress than that recorded. It should be kept in mind that the item of time is of the greatest importance. The days are going by very quickly, and the pity is that the subscriptions are not keeping up the pace set by time. The actual money pledged, up to the 11th inst., amounts to $40,816.28, and perhaps $15,000 in addition is as good as pledged. In the new subscriptions listed in this issue there is one that does credit to those who made it. We refer to the sum handed in by the proprietors of the Central Gas Light Company, of this city. If a proportionate spirit pervaded the other metropolitan companies, there would not be much doubt about the gas building, in fact, New York and Brooklyn would be entitled to the palm for liberality and fraternity. Emulation in liberality was never known to bankrupt anyone. Gentlemen, it is for yourselves to say whether or not gas is to be shown at the Fair in its best estate. The additional subscriptions are appended :

May 4.	Brooklyn Gas Lt. Co., Brooklyn, N. Y.	$1,800 00
" 5.	Nassau Gas Lt. Co., Brooklyn, N. Y.	500 00
" 5.	American Gas Co., Philadelphia, Pa.	300 00
" 5.	Peoples Gas Lt. Co., Cleveland, O.	100 00
" 6.	Central Gas Lt. Co., New York	700 00
" 6.	Northern Gas Lt. Co., New York	300 00
" 9.	Helme & McIlhenny, Philadelphia, Pa.	300 00
" 10.	*	250 00
" 10.	†	250 00
" 11.	Pawtucket Gas Co., Pawtucket, R. I.	100 00
	Total	$4,600 00
	Previously reported	36,216 28
	Grand total (to May 11)	$40,816 28

* Here is given the name of a Philadelphia publishing company.
† Here is given the name of a New York publishing company.

THIS WEEK AT DETROIT.

The appointed hour is at hand and the beautiful City of the Straits is the place where, on Wednesdry next, the clans will be mustered in force to recount before the Western Gas Association the triumphs and the failures, the joys and the trials that have been the respective portions of its members during the interim of the Louisville reunion a year ago. We are in receipt of a copy of the handsomely prepared volume that holds within its covers the papers that are to be read at the meeting, and our "guesses" of a week ago as to the technical value and clearness of the way in which the authors have treated the themes selected by them for elaboration are more than born out by that which is before us. The one who edited, compiled and arranged this volume is entitled to very great credit for the work as a whole, and in its parts. In fact, we do not hesitate to say that no like preparation in advance of the meeting of a technical body has been seen in this country. It is as near to perfection as can be. Not having (up to Thursday evening, May 12th) heard from Secretary Littleton that he had obtained the fare rate concession usually granted, we fear that the General Traffic Association, or whatever its official or authentic title may be, has remained obdurate to his reasoning and appeals, but word could yet be had in time* for its availability. On the other hand the "General Traffic," etc., branch at Chicago is not so "strong" as is the case when the situation at Detroit *per se* is mentioned; for it will be seen from our "item" columns to-day that Fred. Shelton and Mr. Heusner have so arranged it that those making the trip between Chicago and Detroit are to have the benefit of the one fare and one-third. So, if all cannot go by way of Chicago, we may and do congratulate those that are to start from the Fair City.

The programme for entertainment is about, in fact, is practically the same as our report of the inventory in last issue, save in respect to serving dinner at the Club House of the St. Clair Fishing and Shooting Club. It seems that those dictators of our "living experiences"—the hotel-keepers of the country—are, as a condiment to the solid side of their annual convention, which is also to be held this week in Detroit, going out to the Lakes and the St. Clair Club House on the day that the Western proposed to visit the place, and the hotel men spoke first—as usual. However, some other club house will do—there are plenty of housing quarters in the district—consequently it is only a matter of a change of rooftree. Mine host Chittenden, of the Russell House, announces that a great many applications for rooms are on his register, which means that the attendance is to be of the usual kind with the Western—the East will certainly send two score of good men and true—and that the meeting will be of a really national scope. Col. Croul, President Cowdery, Secretary Littleton and Superintendent Baxter have been working like Wolverines, for at least three months, to put things in shape, and the best way to pay them off is to descend upon them in great force. Fair weather and "deep water on the flats" will complete the measure of the matter. May both be experienced to the fullest light and depth.

The Market for Gas Securities.

The events of the week in the city gas share market were the annual meeting of the Standard Company and the developments respecting that mysterious East River gas charter. The Standard meeting passed off harmoniously, although at one time it looked as though a shell was about to burst, when Mr. Sloanaker handed in a resolution, the wording of which ought to cause a change in the pulse of ex-President Bostwick. The language of it is very plain, and the presentment is terse. Stockholders have the right to call at the office at any time and look it over. The Directors chosen were: Chas. Dana, Russell Sage, John T. Terry, D. H. McAlpin, Oliver S. Carter, Frank Tilford, E. V. Loew, H. H. Brockway and F. McKeige. To-day (Friday) the Directors elected the following officers: President, Chas. Dana; Vice-President, Russell Sage; Secretary and Treasurer, F. McKeige. The Company now seems to be on the road to success.

The East River developments disclose that eminent gas engineer and wonderful financier, Emerson McMillin, of Columbus, St. Louis, New York and London, in the title role of King of the East River Diving or Tunnelling Gas Company. The scheme is to make gas in Long Island City and push it over to this city, where it is to be retailed. Fudge and nonsense. We are calmly told that out of-town capital is at the back of the enterprise. The profits are likely to be suburban ones also. City shares are strong and higher. The Brooklyn tangle ought to be unravelled shortly, the Presidents of the Companies having held a meeting last Thursday at which the affair was discussed. We have (Friday noon) no information about what was done. The quotations are about as they were last week. The outside market is generally strong.

* On Friday we received the news that the Secretary had obtained from the Central Traffic Association an agreement securing the one fare and one-third rate on its lines in the district bounded on the East by Pittsburg, and thence out to the Mississippi river. Circulars regarding the same have been mailed to the members by Mr. Littleton.

The Enrichment of Gas in Bulk by Means of Carbureters.

[Contributed by Mr. F. W. Clark to the proceedings of the Southwest of England Association.]

The question of how best to enrich ordinary coal gas has been discussed at many of the meetings of the different societies of gas engineers. A paper was read on this subject in November, 1890, by Mr. Frank Livesey, before the Southern District Association of Gas Engineers and Managers, which treated of the same process as is described in this paper, and to which reference will be made. The process is the introduction of the vapor of carburine—a light petroleum spirit of a specific gravity of .680—by drawing a small portion of the gas to be enriched from the main, and after mixing the vapor therewith, forcing this rich gas so produced back into the main, thereby enriching the bulk.

The evaporator is in the form of a vertical tubular boiler, the tubes running between two plates, which latter are fixed at about 8 inches distance from the top and bottom of the casing. Steam is introduced between these plates and the outside of the tubes. The enriching material is pumped from the store-tank (which is placed underground) by a small steam-pump into the evaporator, at a point below the bottom plate, and is forced up inside the tubes ; the effect being that the spirit is evaporated—thus forming a pressure of vapor, which is conducted by a tube fixed above the top plate of the evaporator, to a regulating valve placed on an injector, which is connected to the gas main containing the gas to be enriched, by small pipes at two points a short distance apart. The vapor under pressure is allowed to pass through the regulating valve into the injector, forming a partial vacuum at the top of it, to which one of the small gas pipes is connected. The effect is that the coal gas is drawn into the injector, where it mixes with the hot vapor, and forms a very rich gas, which is then driven through the second connection back into the gas main, to mix with the bulk of gas at a point nearer to the gasholder or the consumer. The quantity of vapor is easily regulated by the valve in the injector. If the pressure of vapor in the evaporator is increased on account of a smaller consumption, the effect will be that less spirit will be thrown by the pump. As the pressure acts on the delivery of the spirit, the level thereof is lowered ; and the amount of evaporating surface is thereby reduced. In the case of an increased consumption of vapor, the action would be just the opposite. The apparatus is, therefore, practically automatic.

The carbureters have been doing practical work for the past two years, in many cases effecting all the enrichment without the use of cannel or other rich coal. The South Metropolitan Gas Company have these enrichers at all their stations. The Gaslight and Coke Company have had them at work at some of their principal works for two years past ; and several more are now being fixed at their other stations. The gas enriched by this process is quite as permanent as that produced by the use of cannel coal. In one instance, in London, the official testing station is upwards of eight miles from the point where the gas is enriched (sometimes to the extent of more than a million cubic feet per hour) 2 or 3 candles, and no loss in illuminating power takes place.

Mr. Frank Livesey, in the paper already referred to, said the cost of enriching coal gas one sperm candle, by the use of cannel coal, was 2.68d. per 1,000 cubic feet ; and by the use of spirit, it was 1¾d. per candle per 1,000 cubic feet. The cost of the spirit was taken at 13½d. per gallon. The present price of carburine—a much more suitable material—is about three-fourths of this price ; thus reducing Mr. Livesey's cost to about 1¼d. per candle per 1,000 cubic feet.

The following are some extracts from Mr. Frank Livesey's paper :

The important point to ascertain first of all was, Will gas, after being enriched, retain its quality ? To test this, 430,000 cubic feet of gas were enriched to the extent of 2 candles, put into a gas holder and left there for 5 days. Practically, no depreciation could be discovered. Another trial was then made, by testing the gas in a district main about a mile from the works. Two jet photometers having been rated to correspond exactly, one was placed at the works, and one at the point of trial. Here, again, the results were quite satisfactory : the gas, however, was enriched 1 candle only. It would have been more satisfactory had the distance been 4 miles instead of 1. . . . . This, however, is not the only advantage, as the gasoline method is much more reliable and certain in its results ; and by its means the quality can be adjusted with certainty to half a candle or less.

Cost of Making Gas in the Ordinary Manner per Ton of Coal.

Black coal, costing 13s. per ton = 10,000 cubic feet of 15.25 sperm candle gas.

Cannel coal, costing 42s. per ton = 12,000 cubic feet of 30 sperm candles.

To raise the quality 1 sperm candle, it would be necessary to use 7 per cent. of cannel coal.

Sperm Candles.		Cubic Feet.	
93 per cent. × 15.25 =	14.18	93 per cent. × 10,000 =	9,300
7 " × 30.00 =	2.10	7 " × 12,000 =	840
	16.28		10,140

Equal to 10,140 cubic feet of 16.28 sperm candle gas.

	s.	d.
93 per cent. of black coal, at 13s. per ton.....	12	1
7 " of cannel coal, at £2 2s. per ton.....	2	11
	15	0
Less 93 per cent. of 12 cwt. of coke, at 8d.....	7	6
	7	6

(Other residuals not taken ; same in both cases.)

Equal to 7s. 4¾d. per 10,000 cubic feet of gas of 16.25 sperm candles, or 8.87d. per 1,000.

	s.	d.
100 per cent. of black coal, at 13s. per ton.....	13	0
Less 100 per cent. of 12 cwt. of coke, at 8d.....	8	0
	5	0

Equal to 5s. per 10,000 cubic feet of gas of 15.25 sperm candles, or 6d. per 1,000 feet.

Cost of enriching by cannel coal per candle, 2.87d. per 1,000 feet.

Cost of Making Gas Enriched by Carburine, per Ton of Coals.

Black coal, 13s. per ton = 10,000 cubic feet of 15.25 sperm candles.

Carburine, 9d. per gallon, 1¼ gallons = 100 cubic feet of 100 sperm candle gas.

To raise quality 1 sperm candle, it will be necessary to use 1¼ gallons of carburine.

Sperm Candles.		Cubic Feet.	
100 p. ct. of 15.25.. =	15.25	100 p. ct. × 10,000.. =	10,000
1¼ gal. of carburine.. =	1.00	1 p.ct. increase in bulk =	100
	16.25		10,100

Equal to 10,100 cubic feet of 16.25 sperm candle gas.

	s.	d.
100 per cent. of black coal, at 13s. per ton.....	13	0
1¼ gallons of carburine, at 9d. per gallon.....	0	11¼
	13	11¼
Less 100 per cent. of 12 cwt. of coke, at 8d.....	8	0
	5	11¼

(Other residuals not taken ; same in both cases.)

Equal to 5s. 10½d. per 10,000 cubic feet of 16.25 sperm candle gas, or 7.05d. per 1,000

	s.	d.
100 per cent. of black coal, at 13s. per ton.....	13	0
Less 100 per cent. of 12 cwt. of coke, at 8d.....	8	0
	5	0

Equal to 5s. per 10,000 cubic feet of 15.25 sperm candle gas, or 6d. per 1,000 feet.

Cost of enriching by carburine per candle, equal to 1.05d. per 1,000 feet.

Besides showing a saving of upwards of 1¾d. per candle per 1,000 cubic feet of gas made, there are other great advantages in using the Gas Lighting Improvement Company's patent process of carbureting. They are : (1) More gas per ton of coal can be made on account of being able to work the retorts at higher and more regular heats ; also a level gauge can be kept on the retorts. (2) More gas per retort ; therefore less cost for labor, wear and tear, capital outlay, etc. (3) The quality of the coke is not deteriorated, as is the case when using cannel coal. (4) Possibility of immediately increasing the illuminating power of the gas to any desired degree, either on the inlet to the gasholder, or on the outlet mains to the consumers, either on the works or in the district. (5) The illuminating power of the gas can thus be regulated exactly to the quality required, thereby saving the cost of the extra quality usually put into the gas, so as to make sure of its going out to the consumer not under the proper illuminating power. (6) Saving in the cost of purification, enabling engineers to oxidize the purifying material as much as necessary. (7) The process also prevents to a very large extent the deposition of naphthaline in the mains and service pipes, carburine being a solvent for naphthaline. (8) Having the power of enriching at hand, in many cases a much cheaper coal can be used, or (what is also an important matter) a better coke-making coal.

Morgans' Gas Generating Apparatus.

On the 3d inst. U. S. Letters Patent (No. 474,178) were granted to Mr. William H. Morgans, of Pontiac, Mich., for an improved method of making gas. Using the words of the specification, we find the inventor saying:

This invention relates to an apparatus for the manufacture of gas, and has for its object the production of an apparatus by means of which gas can be produced from water with the use of raw or uncoked bituminous coals, and in which the gaseous products emanating from the coal may be employed either alone or in unison with the hydrogen and carbonic

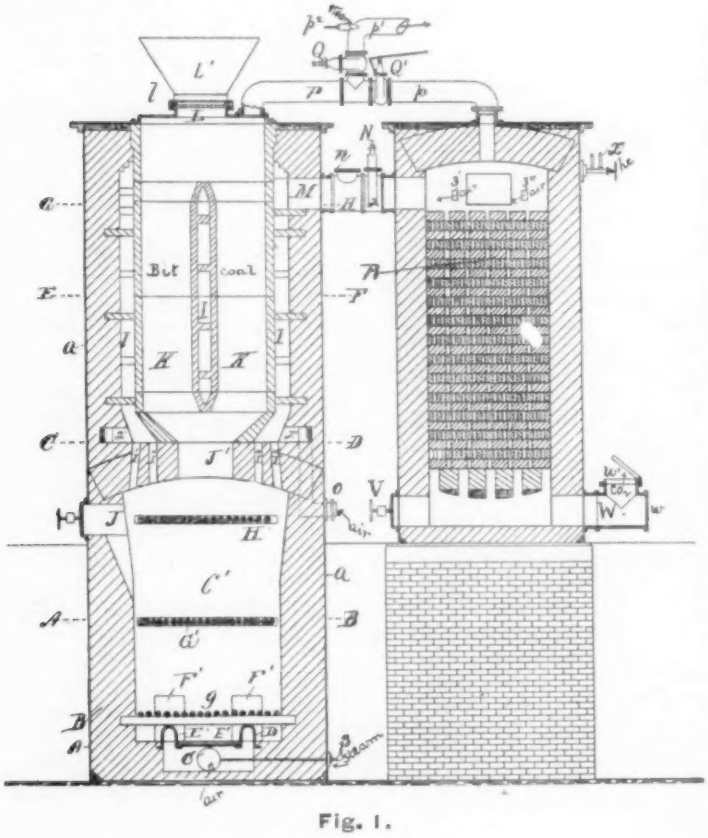

Fig. 1.

oxide produced from the water in the presence of incandescent carbon. As is well known, one of the common ways of producing illuminating gas is to decompose water into the elements of oxygen and hydrogen by throwing a jet of steam through a mass of incandescent coal or coke, where the oxygen of water combines with a portion of the carbon of the coal, forming carbonic oxide and setting the hydrogen free. The two gases thus formed are then conveyed into another chamber, where, by the addition of a hydrocarbon, they are enriched to the required illuminating power. It is usually necessary to employ in the process of manufacturing such a gas expensive anthracite coals, or if bituminous coal is used, it must have been previously prepared in form of coke.

In operating my invention I make use of a soft or bituminous coal, reducing it to a coke in the apparatus itself, which is arranged in such a way that the coking chamber is directly over and feeds constantly into the generator, while the gas which is drawn from the soft coal in the process of reducing it to coke is conveyed into the gasholder and utilized.

The apparatus is shown in the accompanying drawings, of which—

Figure 1 shows in section the generator, the coking chamber above it, and the superheater. Fig. 2 shows a cross-section of the coking chamber and surrounding flues at the line *G H*. Fig. 3 shows a cross-section of the same at the line *E F*. Fig. 4 shows a cross-section at the line *C D*. Fig. 5 shows a cross-section of the generator at the line *A B*.

A represents a shell of boiler iron, lined with firebrick and having doors or passageways through the walls at various parts for the purpose of communicating between the outside and inside; and of these openings E^1 E^1 are doors underneath the grate, through which ashes and incombustible material can be withdrawn.

J represents a door near the top of the generator, through which the coke can be leveled, or the fires in the generator attended to.

F^1 F^1 represent doors near the lower part of the generator, but above the lowermost grate, for the purpose of drawing fires or removing clinkers and cleaning fires.

L represents an opening in the top of the coking chamber, closed by a valve *l*, which shuts off communication between the coking chamber and a hopper L^1, arranged to receive a supply of coal.

Between the coking chamber and the generator is a passageway J^1, constantly open, and allowing free access of coke from the coking chamber *K* to the generator C^1.

D represents a hollow supporting bar open on its under side, and having its walls perforated, to permit the passage of air from an air blast inlet *c* into a space underneath the grates *g*. Through this hollow supporting-bar also passes steam from the steam pipes *S* when the apparatus is being utilized to decompose water admitted to it in the form of steam.

Through the walls of the generator are inserted about midway between the top and bottom of the generator a number of tubes or pipes set in the firebrick, through which the round grate bars of the second grate G^1 may be inserted whenever the apparatus is being used to drive the gas from the bituminous coal and is not being used for the purpose of decomposing water, as will be explained hereinafter, there being suitable doors riveted to the shell to allow of the grates being put in or taken out when desired. Fig. 5 shows these tubes and part of the inserted bars G^1, together with the doorways. At a still higher point in the generator, at a short distance below the outlet J^1 from the coking chamber is a similar set of tubular perforations through the walls of the generator, through which a supplementary set of grate bars may be inserted to support the coal or coke and prevent it from dropping down into the generator whenever it is desired to remove the contents of the generator entirely.

Above the generator is an arch supporting the coking chambers *K* and perforated by the opening J^1 between the generator and the coking chamber and by numerous small passageways I^1 I^{11} I^{111} I^{1111} between the generator and the flues *I* around the coking chambers. On the arch rests the bottom end of the vertical coking chambers *K K* (shown in

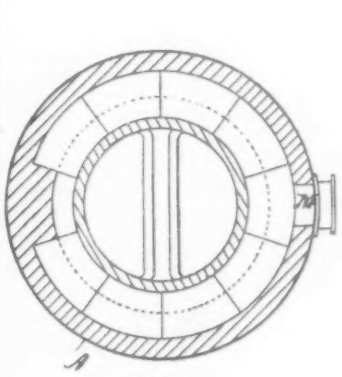

Fig. 2.

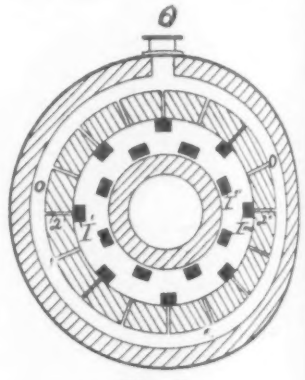

Fig. 3.

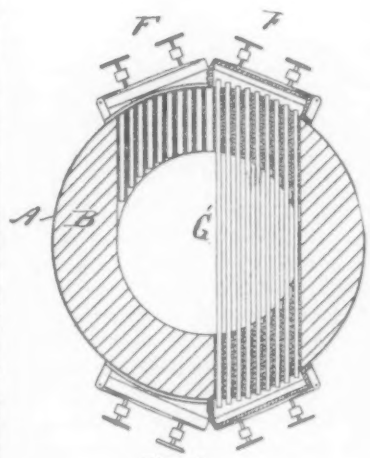

Fig. 4.

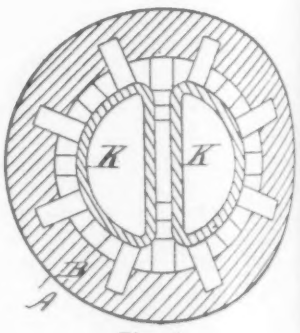

Fig. 5.

these drawings as two), but their number may be either more or less than two, the requisite being that the interior passageway from top to bottom shall be large enough to prevent the coal from clogging, while the confining walls shall present the largest possible surface to the heated gases arising from the generator. A secondary supply of air is admitted into flue *I* above the arch through the valve closed opening *O*, the annular passageway *O*, and leading in through passageways 2^1 2^{11}. (Shown most plainly in Fig. 3.) These air passageways are equal in number to the passageways I^1 I^{11}, and are so located that an air

passageway comes opposite and feeds into each one of the passageways I^1 I^{11}.

The top of the flue I communicates with the interior of the superheater R by means of the pipe M, and the passage of the gaseous products from the generator though this pipe is controlled by the valve N.

From the upper part of the coking chamber a pipe P leads outward and branches into two pipes P P^1, of which P leads into the superheater and P^1 leads to the washer or storage tank, the direction to be taken by the escaping gasses being controlled by means of two valves Q Q^1. Into the pipe P^1 leads a steam jet P^2, used to produce an exhaust or relieve excessive pressure on coking chambers at certain times during the production of the gas.

The superheater P is filled nearly full of firebrick or other refractory material placed in a checkered position form, loosely, so that the heated air or gas can pass freely through it, while at the same time the mass will furnish a large heated surface to be utilized for the purpose of gasifying and fixing the hydrocarbon used to enrich the coal and water gas. Openings 3^1 3^{11} communicate with the interior superheater and furnish an additional supply of air to complete the combustion of the gases passing into the superheater when the contents of the superheater are being heated, as described. The hydrocarbon oil is admitted through the pipe x when enriching the gas. At the bottom of the superheater is a door V, an eduction pipe W leading out and branching, one branch W leading to the washer or storage tank and the other branch W^1 leading to the smokestack.

The operation of my invention is as follows: In starting my apparatus it is necessary to fill the generator C^1 and part of the coking chambers with coke sufficient to heat the coking chamber and superheater before charging with bituminous coal. A fire is started and the air blast admitted through c underneath the grate. The heated gases arising from the generator (the valves Q Q^1 being both closed and the valve N opened) pass into the flues I, where a secondary supply of air is admitted through the inlet pipe O, and the gases are burned in contact with the walls of the coking chamber, heating the same, and passing thence into the superheater, down through the "checker-brick," raising those to a high temperature, and passing away into the smokestacks.

After these chambers are sufficiently heated the air valves, the stack valve, and the valve marked N are closed and the valve Q^1 opened. Steam is then turned on underneath the grate G of the generator. This, passing up through the incandescent coke, is decomposed, forming carbonic oxide and hydrogen gases, which, passing up through the chamber K, take up the gases which are there being driven from the soft coal, and with them pass into the superheater, where they are properly enriched by the admission of hydrocarbons, the vapors of the hydrocarbons being mingled with the gases from the coal and water and "fixed" by the hot checker brick, through which the combined gases are passing, and the united product passes out through the pipe W to the washer or storage tank. The steam jet p^2 is employed as an exhaust to draw off the coal gas from the coking chamber K during the period of reheating, when the products of combustion are passing up around the coking chamber through the flue I and across through the pipe M into the superheater; but care must be used when this is employed not to exhaust so excessively as to introduce nitrogen in excess from the decomposition of the air coming from the air blast C. The bituminous coal is admitted into the coking chambers from the hopper L^1 as it is needed to fill them and to furnish coke for the generator; and when in the process of manufacturing water gas the temperature of the bed of carbon or coke in the generator has been reduced by the passage of steam through it, so that it will no longer decompose the steam, the steam and oil are shut off, the valve N is opened, and the valve Q^1 is closed. The valve W^1 to smokestack is opened, and the process of reheating the coking chamber and superheater proceeds anew. During this time the valve Q is opened and the exhaust jet p^2 is brought into use.

During the night, or at a time when it is desired to leave the apparatus without care, the secondary grates G^1 are placed in the generator and the ashes, clinkers, etc., are removed from beneath them, leaving a clean bed of fire above them. One of the doors E^1 is opened to permit the ingress of sufficient air beneath the fire, and the valves are arranged to cause the products of combustion to pass into the flue I and have their exit through the pipe n on the connection between the generator and the superheater. During such time the combustion of gaseous products from coke in the generator is assisted, if necessary, by admitting a secondary supply of air, which is heated in a passage way built in the brick lining, and passes into the flue I through the air pipe O, and during such time the coking chambers are filled with coal in process of transformation from coal to coke.

The regulating of the various valves and dampers to effect the various results desired is easily learned and the regulation easily attended to by one who has experience with the apparatus.

Whenever it is desired to thoroughly clean out the generator, the supplementary grate bars H are inserted, and these serve to hold up the coke in the coking chamber, while they permit the withdrawal of all fire, ashes, and clinkers from the generator.

I prefer to make the coking chamber in one or more upright parts, coming together in a single part at the top and in a single discharge orifice at the bottom.

What I claim as novel, and desire secured to me by Letters Patent, is—

In a gas generator, the combination, with a combustion chamber, of an arch for the same, having a series of flues therein near the outer edge and a central feed-opening, a coking chamber above and communicating with the combustion chamber through the feed-opening, a flue surrounding the coking chamber, communicating with the combustion chamber through the flues in the arch, an air flue at the base of the coking chamber, a hollow central partition in the coking chamber, its center communicating with the surrounding flue, and an exit for the coking and combustion chambers, substantially as described.

The Use of Petroleum in Prime Movers.

Towards the close of March Prof. W. Robinson concluded the series of lectures delivered by him before the English Society of Arts, on this subject. On the occasion noted the Professor took up the application of petroleum as a fuel for steam boilers. The first appliance, for using oil in this manner described, was Mr. Holden's injector as used on the Great Eastern Railway. In this device oil and air are drawn in by the action of superheated steam as in an ordinary injector, but lest the jet on issuing should be of the blow-pipe type and so injure the interior of the firebox, it is further broken up into a lambent flame by an auxiliary supply of steam issuing from a ring jet surrounding the orifice of the injector. The firebox is fitted with a firebrick bridge towards which the jet is directed, and the bars of the grate are covered with a thin layer of coal and chalk, the former of which burns slowly away. These engines can be run with coal without requiring any alteration to the furnace, a point of great importance in countries where the price of oil is fluctuating. The oil used by Mr. Holden is a mixture of two parts of coal tar with one of green oil, the cost being about 3 cents a gallon. This injector has been modified by fittings, so that it may obtain its air supply from the train pipe of a vacuum brake, and in this way the vacuum is produced and maintained, without any extra expenditure of steam. In marine practice the injector has been fitted to draw in heated air, thus economising fuel. Many modifications of these injectors had been proposed, such as Thwaite's, in which the spray did not pass directly into the firebox, but first into a red-hot drum in which oil was converted into oil gas before being burnt. The most complete system of employing oil as fuel had been worked out in Russia by Mr. Urquhart. In this locality coal is dear and petroleum residuum or astatki is very cheap. Nine years' experience of the system here have shown a notable economy to result from using the heavy petroleum refuse as fuel.

Exaggeration as to the calorific power of oil fuel was to be guarded against. By means of Favre and Silbermann's results, and those of Dr. Andrews, an approximate calculation of the calorific power of a fuel, the chemical composition of which was known, could be made in a way that was well known. But these values were not determined under the conditions which obtain in practice, and several necessary corrections were pointed out before the effective calorific value could be arrived at. As regards the use of creosote and blast furnace oil as fuel, Dr. Sadler, at Middlesbrough, had made a number of careful experiments, which showed that in the same boiler working under the same conditions, 1 pound of creosote would give an effective evaporation at 50 pounds per square inch pressure of about 12.3 pounds of water, whilst 1 pound of Durham steam coal evaporated 8 pounds, the feed water being supplied at 212° F. in both cases. But in addition to its greater evaporative power liquid fuel had many other advantages in the ease with which the fires could be controlled, so that the output of steam could be readily proportioned to the work to be done, and taking this into account, Dr. Sadler concluded that in practice 1 ton of oil was equivalent to 2 tons of coal in evaporative power. In spite of this superior evaporative efficiency, oil fuel was not necessarily more economical from a commercial point of view, as in most countries coal was considerably cheaper than oil, but where oil refuse could be obtained cheaply there was no doubt of its superiority. Thus Mr. Urquhart found that on his railway line a particular class of engine burned 79.08

pounds of coal per mile, whilst similar engines, fitted for oil burning, used only 40.47 pounds of astatki, and in special trials on large engines 45 tons of astatki were equal to 100 tons of anthracite. On the Great Eastern Railway Mr. Holden finds that, using oil, the consumption per engine mile averages 12.2 pounds of oil and 11 pounds of coal, or a total of 23.2 pounds of fuel per mile. Burning coal alone, however, similar engines use 34 pounds of coal per mile. On the Argentine Great Western Railway, engines using 33 pounds of fuel per mile, when burning coal, use only 22 pounds of oil. On the Tralee & Dingle Railway, where the coal consumption was 54 pounds per engine mile (the grades being very heavy), only 8 pounds of coal and 18 pounds of blast furnace oil, or a total of 26 pounds of fuel, are burnt when using Mr. Holden's apparatus, and a decided economy effected. On the Argentine Railway, where coal is very dear—about $20 a ton—the saving by the use of petroleum fuel amounts to $2,245 per engine per annum. In the case of steamships oil had additional advantages. In the first place, having a great calorific intensity, less of it was required, and a saving of cargo space would be effected. Moreover, coaling at sea, which was now a difficult operation, and which could only be accomplished in fine weather, could be done away with, as oil could always be easily transferred from one vessel to another by means of a suitable hose. On the other hand, the oil tanks when emptied of oil were liable to contain a dangerous gas which might cause serious explosions unless proper precautions were taken by using proper oil storage tanks and a suitable form of safety lamp to detect the presence of an inflammable mixture, naked lights being strictly forbidden.

The last way in which petroleum was used in prime movers to which he would refer was for lubrication. The mineral oils suitable for this purpose were distilled off after the intermediate oils had been collected. These oils had great advantages over animal or vegetable oils in that they did not absorb oxygen from the air, and thus cause spontaneous combustion. Heavy mineral oils were specially valuable for bearings, spindle and steam cylinder lubrication, because they retained their good properties when heated, and did not thicken and oxidize like fixed oils.

Several of the practical tests of lubricating oils were considered, and the viscosity meter of Mr. Boverton Redwood described, and the method of using it explained. Many machines had been devised for testing the value of oils for the purpose of lubrication, but they were all somewhat unsatisfactory and after all the best test was experience.

Properties of the Saturated Vapor of Ammonia.

Prof. De Volson Wood, in a recent issue of the *Stevens Indicator*, says that about two years since, he computed a table of some of the properties of the saturated vapor of ammonia. The formulæ were his own, deduced from hypotheses of Rankine, and Regnault's experiments were used to find numerical values. Regnault made experiments to determine the pressure corresponding to the temperature of the saturated vapor, and also the relation between the pressure and volume of the superheated vapor (or gas) at the constant temperature of 8.1° Cent.

It will be interesting to note the degree of accuracy of Prof. Wood's table, when compared with direct experiment.

Dr. Von Strombeck, chemist, found by direct experiment that the latent heat of vaporization of ammonia ($N H_3$)

At 32.45° F., was	534.2	heat units
Prof. Wood's table gives	435.81	"
Difference	0.98	"

Prof. Jacobus found that Regnault had made a determination of this constant, and after a somewhat elaborate investigation concludes that Regnault's experiments give

At 53° F	521.64
Prof. Wood's table gives	522.39
Difference	0.75

According to these results, the Wood table is practically exact, although no table founded on the results of experiment will be theoretically exact. All experiments are subject to residual errors, and, in this case, the formulæ are provisional—or, in other words, are somewhat empirical, and it is too much to expect that they will give results strictly correct. The results of experiments of Von Strombeck and the reductions by Prof. Jacobus are, at best, very probable values. Still, it is gratifying to all parties that the results, independently obtained, agree so nearly. Prof. Wood thinks it may be said, with confidence, that his table of the properties of the saturated vapor of ammonia is the most reliable of any now known.

The Manufacture and Industrial Applications of Flexible Tubing.

[A paper read before the English Society of Arts by Mr. Gilbert R. Redgrave, C.E.]

The history of the extensive use of flexible tubing seems to be most closely related to that of India-rubber, which substance, in its various forms, has furnished the principal descriptions of flexible tubing at present in the market. Previous to the discovery of caoutchouc, the name by which the raw rubber was at first known, and which was the South American Indian word denoting the India rubber tree—the *Siphonia elastica*—the different kinds of flexible tubing seem to have been prepared either from strips of leather fastened together by means of copper or metal rivets, or by winding thin bands of linen or other fabrics, soaked in gums or varnishes, round a mandrel or core. The use of tubes or hose, woven in a circular form without a seam, is an invention of much later date, and would appear to belong to T. B. Brown, who patented a seamless hose in 1849, though he seems to have been anticipated by Hegner as long ago as 1792.

The commercial employment of India-rubber—the inspissated or coagulated juice of several varieties of trees—dates back to the early years of the present century, but it scarcely attained to any real importance until Hancock's spreading process, which was made known in 1837, or the perhaps even more important invention of the process of vulcanizing rubber, or causing it to combine with a certain percentage of sulphur, which was patented by Hancock in 1843. Another epoch-making event in the history of this material was the plan of cold curing, which involves the use of carbon bisulphide, discovered by Parkes in 1846. It is scarcely necessary that I should trouble you now with the history of India-rubber manufacture, for this matter has been dealt with on previous occasions in this room, and the various processes were fully described by Mr. Bolas, in a series of Cantor lectures, in 1880. I may, however, very briefly allude to that branch of the manufacture connected with the production of tubing of this material.

India-rubber tubing is manufactured by two distinct methods—

1. By squeezing or squirting the prepared semi-fluid rubber through a die or orifice; and

2. By the mechanical jointing of hollow cylinders of sheet rubber.

In a machine invented by Mr. Francis Shaw all the requisite ingredients are conveyed, by means of a hopper, into a horizontal cylinder, kept at the requisite temperature by a steam jacket. In the interior of this cylinder the rubber is compressed by the action of a piston or plunger, and is forced out at the end through a die or nozzle of any required section. The tube, as it emerges, is coated with powdered steatite, and is packed in a layer of this material, in order that it may be vulcanized by means of dry heat, in a vulcanizing chamber. It is then ready for the market.

In the second process India-rubber is spread upon sized cloth and stripped into sheets. It is then cut into strips of the right width to furnish a tube of the requisite diameter, when bent round into a cylindrical form. Next the cut edges are beveled, which causes the surfaces to unite more perfectly when brought into contact with each other. The strips are then passed through a heated die, being previously doubled into the form of a cylinder. In their passage through the die—which is of the requisite size to form the tubing—the beveled edges are compressed together and made to unite. In this way a tube is produced, which, as it issues, is coated, as before described, with steatite powder, and subsequently vulcanized.

The red colored rubber tubing, which is considered by some to be more durable than the gray, is made by employing orange-red colored antimony pentasulphide with the "mixing"—the technical name for the prepared ingredients—and the superior strength of this rubber does not in any way depend upon the coloring matter, but must be due to better quality in the mixing.

The production of a flexible tube or pipe of metal has long been a desideratum, and the subject has not escaped the thoughtful attention of inventors, as a brief scrutiny of the records of the Patent Office will not fail to show. I cannot hope on the present occasion to bring under your notice a tithe of these inventions. I may, however, point out that a favorite plan of overcoming the difficulty involves the use of coiled wire, either alone in several thicknesses or in conjunction with a metal strip of some other section. I have some specimens here of some of these varieties of tubing; thus, under an ingenious plan of American origin, tubing is produced by the combination of a wire and a triangular fillet. It will be readily understood that a tube constructed in this way on the helical principle would be possessed of considerable strength, though I should be inclined to doubt its tightness, owing to the small

extent of metallic surface in contact, while the relative weight of metal required per foot of tube is more than treble that of the invention I shall hereafter describe.

Another method of building up a flexible tube is on what has been termed the accordion system, wherein numerous thin concave discs of metal are soldered together alternately, at their inner and outer edges. This really constitutes a series of rings, or a tube is produced on what is termed the annular system. Such a tube is a very flexible, but not a very strong one; and this cannot fail to be, of course, a relatively expensive plan of obtaining the object in view. Flexible tubes have also been produced from super-imposed coils of channel and half-round sections of corrugated metal, having a packing of India-rubber at their junctions. The section of this kind of tubing is very similar to that first employed in the invention of Mons. Levavasseur. By binding India-rubber tubing externally with a spiral coil of wire, and introducing within the rubber tube a lining of coiled wire, the different kinds of so-called "sphincter-grip armored hose" are produced.

A moment's consideration of the difficulties involved in the manufacture of a flexible metallic tube will serve to indicate not only the direction in which the question has to be approached, but also the readiest method by which the task may be accomplished. It is clear that to obtain flexion the tube must be built up of a vast number of small moving parts, and that the degree of flexibility will, to a great extent, depend upon the relative size of these parts. If we contrive a joint which admits of a certain amount of play, and this joint occurs at certain fixed intervals, the total extent of flexibility in a given length of tubing will be contingent upon the extreme amount of play at each joint, multiplied by the number of joints in such given length, assuming always, as we are bound to do in the case of a tube of metal, that the sections themselves are rigid. The movement or play must, therefore, in the case of a tube of metal, be provided at the joint. Now, a very brief study of the problem will further teach us that such a tube may best be formed from a continuous strip of metal spirally wound, as it would be impossible, or next to impossible, on the score of cost, to contrive a series of rings, securely jointed one within the other on the annular system, with movable joints, each of such rings being sufficienty narrow to insure the due degree of flexibility in the tube.

For many purposes, it is true, where a very slight degree of flexibility is required, the provision for such play is secured by joints of the above-mentioned kind. Thus, for earthenware or stoneware pipes, which, as you are aware, have to be laid in trenches, and which, even with the utmost care in the laying, are liable to slight movements by settlement or displacement, a joint, known after its inventor, Mr. Stanford, has been devised, in which the spigot end of the one pipe has a ring of pitch or composition, which fits into a faucet in the adjoining pipe similarly prepared. As will be evident from the form of this joint, a small amount of displacement would not be fatal to it, while a rigid joint, formed of cement or similar material, would be crushed by a very slight settlement. For the junction of metal pipes, which are laid in much longer sections, generally of 9 or 12 feet in length, a very ingenious joint has been devised, which depends upon the elasticity of a ring of vulcanized India-rubber, resting in a grove on the spigot of the pipe, and rolling into the faucet when the two pipes are forced together to make the joint. The tightness of this joint depends, of course, upon the soundness of the rubber; and, as I shall show that rubber used in this way is liable to deterioration and decay, we are bound to assume that this is not a joint of a permanently durable character.

All engineers are aware that it is no easy matter to produce an absolutely tight joint between two metal surfaces; and for this reason alone most of the earlier efforts to obtain a flexible metal tube were based on the use of some foreign substance to form a packing. This substance was generally a strip of India-rubber, and for the reasons already given, the first flexible metal tubes could not be regarded as otherwise than imperfect from the point of view of durability.

As I have already pointed out, the problem of making a flexible tube of metal was found to depend upon the method of coiling a strip of metal in a spiral form round a mandrel or core in such a way that the continuous joint or seam between each coil of the helix was not only perfectly sound, but was also possessed of mobility. In tracing out the gradual steps by which this problem has been mastered, I shall have to bring before you the history of the so-called flexible metallic tubing, the invention of Mons. E. Levavasseur.

M. Levavasseur has given me the following brief account of the details of his discovery. Some 20 years ago, while engaged in the manufacture of jewelry, he produced bracelets and necklaces of thin laminæ of gold and silver, the original form of which was tubular; the tube being built up of strips of metal of two different sections, coiled one above the other. To accomplish this a flat channelled section is first employed, above which is wound a semi-circular clip, serving to unite the channels together, and to form a complete tube. This pattern, either circular in section or flattened into an oval form by hydraulic pressure, was for many years in great request for necklaces of gold and silver, and M. Levavasseur was profitably employed in their manufacture under the terms of a patent which he had obtained for the invention. In time, he was able to produce necklets and other ornaments from coiled metal strips on the interlocking principle, having an S section, where only one continuous strip is used, and the convolutions grip one into the other. While he was engaged in the manufacture of jewelry, he designed nearly all the different forms of corrugation now used for tubing.

It was not till about six years ago, when he was walking one day with his partner in a Paris thoroughfare, that the invention, in its present shape, took practical form. He saw the men engaged in cleansing the asphalt with that curious apparatus which is so frequently seen in Paris, but which I do not remember to have met with elsewhere, viz., short lengths of piping, carried on a pair of small wheels fore and aft, and joined together by copper riveted leather hose, to secure flexibility. M. Levavasseur remarked to his partner that this seemed a very unwieldy and cumbrous contrivance, unworthy of the 19th century, and he was surprised that something different was not introduced. His partner said that they used it in default of some better substitute, which had still to be provided. Said M. Levavasseur, "I could contrive something much better adapted for the purpose, and far lighter and more flexible." On being asked to explain, he said, "I should make an enlarged tube of the same kind as we use for the spiral necklaces, and insert a strip of India-rubber between each coil to make it water-tight." His partner saw at once the value of the notion, and it was forthwith patented, and has now been developed into the tubing I am able to bring under your notice this evening.

Starting with a simple ribbon of metal, which we will, in the first case, regard as perfectly flat, but capable of being coiled in a spiral form round a core, we should obtain a tube; but in order to obtain a cylindrical tube, we must assume the metal to undergo a certain amount of distortion, for the tendency of such a strip would be to take the form of a truncated cone. This fact may be familiarly illustrated by a strip of paper wound in the required manner to form a spill, which, it is well known, tapers from the base upwards. A tube thus wound would obtain its flexibility by the sliding of one coil over the other; but the flexibility in this case, would be very trifling, the coils would very readily be strained apart, and would be very liable to become clogged with grit and dirt. As a matter of fact, it would be quite impossible to produce in this manner, even with a strip of India-rubber inserted along the seam, a sound and tight flexible tube.

Starting, then, with the plain strip, it appears that means must be devised to form something superior to the simple lap-joint we have just investigated. The strip must, in fact, be corrugated, and in the first form of the invention the strip was corrugated by a similar process to that by which iron bars of various sections are drawn out in the rolling mill. In the strip originally employed, the section somewhat resembled the form of a double channel, and the strands or coils of metal were hooked together and grasped between them a small strip of rubber. The tightness of this joint clearly depends upon the presence of this rubber, and the play or flexibility is contingent upon the amount of movement possible of the one hook within the other. When the tube of this description is bent, the tendency will be for the joints along the outer edge of the curve to draw closer together and to bite more firmly on to the rubber strip; but, on the other hand, for the corresponding parts of the joints on the inner face of the curve to open out and relinquish their grasp of the rubber. It will be apparent from the section, that in tubes exposed to much flexure there will be a great strain on the rubber, and it was found, in practice, that this joint, though it gave great flexibility, rapidly caused the rubber strip to work out and deteriorate. Not only, therefore, was this particular form of tube defective, in that it relied mainly for its soundness upon a perishable substance—the rubber—but it also exposed that rubber to an undue amount of wear and tear.

In the next stage of the invention we find strips of a fresh section employed, more resembling the figure of 8, and giving a much more perfect interlock between each coil. In tubes constructed of this section there is less flexibility, perhaps, than in those of the double channel type, but the rubber is much more securely embedded, and the tendency of the latter to work out is greatly reduced. Moreover, it becomes impossible for the coils to be drawn apart even under very great pressure, and the disruption of the tube can only be effected by a force sufficient to split the metal strip. Several types of this interlocking section, which were in turn introduced and tested, are shown in my diagrams. Where

the rubber is so placed that it is gripped by the double hook, it becomes possible to cut the rubber to pieces by frequent and violent bending of the tube, but several of these sections seem to have overcome entirely the tendency, on the one hand, of the rubber strip to work out, and on the other, of the different coils of the metal to draw apart. The rubber strip, though it conveys an element of weakness, may, under certain circumstances, be employed with advantage. For instance, in flexible tubes, where the contents are at very low pressures, as in the case of gas tubing, the rubber may safely be introduced ; but where the tubes have to be steam-tight, and where the contents of the tube are under great pressure, it is convenient to dispense altogether with the rubber strip. While I am dealing with this part of the subject, I may mention that, when rubber is used in an iron or steel tube, it remains practically unchanged for considerable periods of time, but that when it is employed in a tube of copper or brass, it appears to undergo some chemical action, which leads to its ultimate conversion into a dark resinous compound, devoid of elastic properties. This altered form of the India rubber, though it serves as an admirable packing between the surfaces of metal, and certainly improves the tightness of the tubing, deprives it almost entirely of its flexibility.

Dr. Burghardt has pointed out that this deterioration is due to the action of oxygen, which is in reality the great enemy of all kinds of rubber. Certain of the heavy coal tar oils, and many oils of animal and vegetable origin, such as tallow oil, olive oil and cottonseed oil, when brought into contact with India-rubber, seem to set up the oxidizing process with fatal rapidity Copper oxide, in conjunction with oil, is a source of peculiar danger to caoutchouc, and in the tubing formed of copper the destructive action has been observed in less than a twelvemonth. For those purposes, therefore, where the use of a rubber strip is advisable, it is necessary to employ a protective coating of tin or some other metal on the surface of the copper to guard against this action. Rubber, when fully oxidized, becomes quite brittle, and is split up into two resinous substances, the one discovered by Spiller is soluble in alcohol, ether, and carbon bisulphide ; the other substance, the discovery of Dr. Burghardt, is not acted upon by those solvents. Oil, which is usually freely employed in the manufacture of tubing, can, in order to obviate this danger, in the case of copper or brass, be replaced by soap and water, or some other lubricant, and an increased amount of rubber may be inserted in the space between the metal coils, to make good the waste.

An attempt to employ a flatter and less violent curve will be seen in the diagrams of certain of the sections, for it is manifest that the toughness of the metal must be severely tried during the process of rolling if the pattern to which it has to be rolled is one composed of a multiplicity of sharp angles. Further progress in the development of the invention shows a more complete interlocking of the metal strands, and slight modifications in the section. After many experiments, it was ascertained that none of these sections gave absolute security, and that the more completely was the interlocking principle carried out the greater was the sacrifice of the flexibility. Moreover, in these later varieties, where the India-rubber strip was closely gripped and compressed by the metal, it was proved that in time it deteriorated, or underwent some chemical or physical changes of the character to which I have already alluded.

Finding, after repeated trials, that it was impossible to produce satisfactory specimens of tubing in which the tightness of the joint was secured by means of a rubber strip, the next stage in the invention was the attempt to manufacture a spirally wound tube in which this might be accomplished by simple interlocking of the coils of metal without packing of any kind. The well known difficulty of producing a sound joint by metal against metal would appear at first sight to interpose almost insurmountable obstacles to success in this attempt, but after further experiments, a considerable measure of success was obtained. To roll a thin strip of flat metal into the section required it would be exposed to very severe strains, in consequence of the numerous sharp angles, and it is necessary to effect the conversion by slow degrees by the use of a graduated series of molettes through which the metal passes many times. This particular section involves six almost right-angled bends, and the manufacture can only be carried out with a very ductile metal like the best soft iron, copper, or brass. The process of evolution, which resulted in the form of metal strip now employed, was a matter involving time and much consideration ; and in the latest section, packing is entirely dispensed with. In its improved form each metal strip has a comparatively large surface in contact with the one adjoining it, and, by the difference in width of the two grooved channels, an ample allowance is made for play. This is, in fact, a piston joint, for the smaller corrugation works within the larger one, as the piston works within the cylinder. In the first form of this joint a notch was rolled upon the summit of the lesser corrugation to receive a thread of hemp, cotton or asbestos, to serve as a species of packing ; but in the present form of the coil, the packing has been entirely done away with, and we find nothing but the two metallic surfaces in contact.

It will appear, at first sight, to practical men who have had experience in metal work, that it would be absolutely impossible, under these conditions to produce a continuous sound joint in a tube of any length, even under very moderate pressures ; but that it should be possible to obtain by this means a steam-tight joint, or one capable of conveying petroleum oil gas at a pressure of 200 pounds per square inch, will scarcely be credited. Such is, however, an undoubted fact, and the tube is not only perfectly tight under these conditions, but it likewise retains much of its flexibility. The only explanation is that in this form of joint the greater the internal pressure, the more firmly are the metal surfaces, which approximately form two sides of a square brought into contact. There is no possibility of torsion, or what would be equivalent to a partial unwinding of the tube, because of the friction of the metallic surfaces ; and as the internal pressure increases, in precisely the same ratio does the tightness or soundness of the tube increase, until the point is reached when the strain on the metal strip produces elongation or partial deformation of the section, and in the tube $\frac{3}{4}$ of an inch in diameter, formed of a coiled strip $\frac{6}{10}$ of a millimetre in thickness and 14 millimetres wide, this would appear to be reached at a pressure of about 2,000 pounds per square inch. Not only is this tube tight at these very extreme pressures, but it is also capable of being used under the diminished internal pressure of a partial vacuum, a fact which is more difficult of scientific explanation than that of its capacity for resisting great internal pressure, for in this case a new set of factors come into play. Still it will be seen, when the structure of the tube is investigated, that the external pressure, due to the atmosphere, will also tend to tighten the coils, when the air in the interior of the tubing is exhausted.

In tubing of this formation the degree of flexibility varies, of course, considerably, in proportion to the diameter and to the thickness of metal ; but, it may be roughly stated, that a $\frac{5}{16}$ inch tube may be formed into a circle 8 inches across, and an inch tube into a circle 12 inches in diameter.

[To be continued.]

Ekelund Peat Coke.

Lieutenant Ekelund, of the Swedish Engineers, has patented a method of coking peat, and his working experiments on a scale of some magnitude have attracted much attention in Sweden, Norway, Denmark, Russia, etc. A strong company, with $150,000, has just been constituted in Stockholm, with Lieutenant Ekelund as chairman, for working the process, and a large factory is at once to be erected. The patents for Norway, Denmark, France and Russia have also been sold. The experiments referred to have been carried out at Omberg, near Motola, in the following manner :

The furnace or oven, built of fireproof bricks, is divided into four chambers, each having a height of 32 feet and being 20 feet square. Herr Ekelund had to rebuild the furnace four times before obtaining a satisfactory result. In the top chamber, whither the peat is conveyed on rails along an embankment, the peat is partly dried and from a great deal of water for two hours. A perforating valve separating each chamber is then drawn, and the peat drops into chamber No. 2, where it is partly coked with the gases conducted from grates in the sides of the furnace, the principal fuel used being peat. After another two hours the second valve is drawn, and the partly-coked peat falls into chamber No. 3, where the process of coking is completed in another two hours. By this time the peat is red hot, and it is then discharged into the bottom chamber, where peat earth is thrown upon it so as to extinguish the fire. When cooled the peat is ready for hydraulic compression, or it may be used in its present state. The gases from the second chamber—*i. e.*, the coking chamber—are discharged into the lowest one after having been purified in a condenser. From the latter they are conducted direct through tubes into the grates, where they are fired, and develop an enormous heat resulting from the coking and drying. As motor for the blowers a steam engine of 30 horse power is used. The furnace is fed every two hours, and is capable of treating 10,320 cubic feet of peat per 24 hours, producing about 48 tons of peat coke. The fuel consumed in the coking amounts to 15 cubic feet an hour, the cost being only $1.35 for the entire 24 hours. In fact, the consumption of fuel in heating peat containing 60 per cent. of water is only 30 hectoliters, the cost of which is less than a one-quarter cent, the process being effected with the gases and the heat developed during

the process. The yield of finished product varies from 1.2 ton per 100 hectoliters peat when required for burning in rooms to 1.8 ton per 100 hectoliters when required for engines, furnaces, etc. The inventor asserts that the peat coke develops in proportion to weight the same amount of heat as best English coal, and whereas the cost of the former, including all charges, is said to be only $2 per ton, that of the latter delivered in Sweden is $5 per ton. It will be seen from this description that the process really consists in peat coking peat. The tar derived from the peat may be used for pressing the finished fuel into briquettes. It may be mentioned that Herr Ekelund's process has been strongly criticised by experts, particularly at the last meeting of the Swedish Technological Society, the chief objections being that his figures are far too low.

Production and Capacity of the Bituminous Coal and Coke Furnaces by States and Districts.

The production and capacity of the bituminous coal and coke furnaces of the country by States and districts will be found in the following table, compiled by *Iron Age* from recent statistics collated by the American Iron and Steel Association :

States.	Number of Completed Bituminous Furnaces, January 1, 1892.	Production of Bituminous Pig Iron in 1891. Net Tons.	Annual Capacity of Completed Bituminous Furnaces, Jan. 1, 1892. Net Tons.	Excess of Capacity of Bituminous Furnaces Over Production in 1891. Net Tons.
Middle States :				
New York..	3	115,410	121,000	5,590
Penna.....	80	2,654,274	3,858,200	1,203,926
Totals.....	83	2,769,684	3,979,200	1,209,516
Southern States :				
Maryland.....	5	127,844	409,000	281,156
Virginia	19	327,103	625,000	297,897
N. Carolina.....	1	3,080	6,000	2,920
Georgia	2	38,205	60,000	21,795
Alabama..... ..	38	803,810	1,407,000	603,190
W. Virginia	4	96,637	184,000	87,363
Kentucky.....	7	46,430	227,000	180,570
Tennessee.....	13	275,504	392,000	116,496
Totals	89	1,718,613	3,310,000	1,591,387
Western and Pacific States :				
Ohio.....	60	1,137,047	2,123,500	986,453
Indiana.....	2	8,657	30,000	21,343
Illinois.....	20	749,506	1,365,000	615,494
Wisconsin.....	4	115,436	177,000	61,564
Minnesota.....	1	1,373	50,000	48,627
Missouri.....	5	16,608	175,000	158,392
Colorado.....	3	20,290	100,000	79,710
Totals.....	95	2,048,917	4,020,500	1,971,583
Grand totals	267	6,537,214	11,309,700	4,772,486

It will be observed that the New England States have been ommitted entirely from the above table, as that section of the country manufactures charcoal pig iron only. In the Middle States New York and Pennsylvania again only appear, New Jersey, as will be seen in the following table, producing all the pig iron made in that State with anthracite and mixed anthracite coal and coke as fuel. The capacity of the bituminous coal and coke furnaces in the two Middle States aggregates 3,979,200 net tons, the production 2,769,684 tons, and the excess of capacity over production 1,209,516 tons. In the Southern States the capacity aggregates 3,310,000 tons, the production 1,718,613 tons, and the excess of capacity over production 1,591,387 tons. In the Western and Pacific States the capacity aggregates 4,020,500 tons, the production 2,048,917 tons, and the excess of capacity over production 1,971,583 tons. In the whole country the capacity aggregates 11,309,700 tons, the production 6,537,214 tons, and the excess of capacity over production 4,722,486 tons. By dividing the furnaces of each section into the production of their respective sections we find that the average production of each furnace in the Middle States was 33,370 tons, in the Southern States 19,310 tons, and in the Western and Pacific States 21,568 tons. The average production of each furnace in the whole country was 24,484 tons. It is doubtless generally supposed that the greatest average production for the bituminous coal and coke furnaces of the country would be found in Pennsylvania, but, as will be seen by referring to the table, this is not the fact, as to Illinois belongs this honor, the average production of each bituminous coal and coke furnace in Pennsylvania being 33,178 net tons and in Illinois 37,475 tons. Pennsylvania, however, has the honor of having located within her borders a single coke furnace which has averaged over 100,000 tons yearly for the past two years, with the probabilities strongly in its favor of reaching over 300,000 tons in three years. This great output was accomplished on a single lining, and exceeds by far that of any other blast furnace in the world. It will thus be seen that in both coke and charcoal furnace records the United States leads the world, the outputs referred to not even being approached by a single blast furnace in this or any other country.

Resume of the Operation of the City Gas Works, Richmond, Va., 1891.

The following is from the Report of the Superintendent (Mr. W. C. Adams) of the City Gas Works, Richmond, Va., recounting the operations for the year ended Dec. 31, 1891 :

* * * By reference to the above figures it will be seen that there has been consumed, for the use of the city, 51,122,600 cubic feet of gas.

The statement of the gas generated shows that 219,686,700 cubic feet of gas were made, showing an increase of 22,696,100 cubic feet as compared with the corresponding year.

At the date of last report there were 1,589 street lamps ; there have been added during the year 45, making a total of 1,634,located as follows : First District, 499 ; Second District, 471 ; Third District, 614 ; First Market, 16 ; Second Market, 14 ; Upper Works, 5 ; Lower Works, 15—total, 1,634.

The receipts and disbursements on account of current expenses are as follows :

Received for gas		$199,948 30
Received for coke, etc.....		25,054 43
		$225,002 73
Disbursed for payroll	$86,458 22	
Disbursed for coal	75,188 15	
Disbursed for expenses	22,039 67	
		183,686 04
Excess of receipts over expenditures.		$41,316 69
To which must be added 51,122,600 cubic feet of gas consumed by street lamps and public buildings, at $1.50 per 1,000.....		76,683 90
		$118,000 59

The maximum consumption of gas in any one 24 hours occurred on the 23d day of December, which was 941,094 cubic feet.

The maximum production of gas in any one 24 hours was on the 23d of December, which was 946,800 cubic feet.

At the date of last report street mains measured as follows : 66 miles, 3,139 feet ; laid during the year 3,469 feet making a total of 67 miles, 1,328 feet. There have been put in for new consumers 210 service pipes, removed and repaired 748, of various sizes, in different sections of the city, removed 38 street lamps, raised and lowered 343 stop-cock boxes on account of alterations in grade of the streets.

Our leakage account for the year is in excess of former years. This is owing to the condition of the holders at the Upper Works ; the crowns of both holders were nothing but shells, and had to be entirely renewed. This could not be done until the consumption of gas was small enough to admit of these holders being thrown out of use ; then we could only spare one at a time, and not until the 8th of August was any part of this leakage stopped. Notwithstanding, we have renewed the crowns of these holders, the sides and cups are liable to give way at any time, and they must necessarily be repaired from time to time until they are put in a condition to hold gas. I must again call your attention to the necessity of another holder ; the great loss we sustained this year from leakage on account of limited holder room should be the strongest argument in favor of building another holder ; under the present system of working, we have neither sufficient holder capacity nor any means of generating gas quickly to meet sudden demands,such as cloudy days and many other causes that very materially increase the consumption temporarily.

Some time since I recommended to the Committee on Light to put in a water gas plant as an auxiliary to our present coal plant. This recommendation was adopted, and the matter is before the Finance Committee. There are very many reasons why the city should introduce a water gas plant. The first and principal reason is that you can make a

better gas, and it can be generated more rapidly; by doing this you can work with less holder room, and you are also in a position to meet any sudden demand for gas during a series of cloudy days. The second reason is that you have in the electric light a very formidable competitor, and it has already made very heavy inroads on your large consumers, especially in the Second District.

In very many places that I can name, gas companies have been forced to put in water gas plants in order to compete with electricity; in one place that I can recall, the electric light made such heavy inroads on the gas company's customers that their dividends were reduced so low that they became alarmed to that extent that they forthwith put in a water gas plant, and are now working it successfully and have regained nearly all of their old consumers who left them to use the electric light. All of these statements can be borne out with facts, and I am prepared at any time to produce them. You cannot expect your superintendent with antiquated machinery and worn out holders to make your works compete with other works that spare no expense in getting the most improved modern appliances for gas making.

I hope you will give this subject due consideration and use your best efforts to put these works in a condition to meet all demands that may be made on them for gas.

Our expense account for the year has been largely increased on account of the repairs to the holders, the rebuilding of 14 benches of 6's, and the purchase of one 20-horse power engine and line of shafting. This increased our expense account over $11,000. The generating department of the works is now in a better condition than I have known it to be for many years; therefore, I am glad to say that if we continue the old coal gas system we will require very little funds for renewals of benches this year, provided the street lamps are thrown out of use by the arc electric lights on our streets. I think, from the present outlook, it will be late in the fall before all of the streets are lighted with electricity.

The quality of the gas the past year has been very good and few complaints have reached me on that account, and in every case where there has been a complaint I have always traced it to local causes.

The officers and employees have been diligent and efficient in the discharge of their respective duties, and to them I am indebted for their hearty co-operation and aid.

Peculiar Behavior of Oil as an Insulator.

Now that oil is universally recognized as a good insulator, and that its use is not patentable, says the *Electrical World*, reports of its shortcomings are beginning to appear which seem to show that, although very good under certain conditions, it has certain peculiar qualities which warn us to proceed slowly with the use of it until we know more about its idiosyncrasies. Prof. Elihu Thompson, who has experimented perhaps more than anyone else in this field, noticed during the course of his experiments some curious anomalies, which at first could not be understood. He found, for instance, that with very moderate potentials, puncture through the oil would occur in some cases through considerable distances, while in other cases the insulation was maintained. His experiments, which are not yet completed, seem to indicate that low periodicities of 125 or thereabouts, and comparatively smooth waves of current, such as are given out by the ordinary alternating current apparatus, will cause puncture of much longer distances under oil than occur with very high period current discharges. In fact, in some of the experiments the striking distances in oil have been approximately like those in air, falling not much below. With potentials from a high period machine giving from 3,000 to 5,000 alternations per second, the insulating quality of the oil seemed to be much better, and his experiments show that with high periods and very high voltages the insulating qualities of oil are all that could be desired. One of the most curious effects which he noticed in the course of his researches was that it takes time to break down oil; that momentary contacts are by no means sufficient to cause puncture, but that if the alternating waves are kept on for periods varying from a few seconds to half a minute or more, the oil may break down at last; and, furthermore, that the wider the distance between the electrodes the longer the time it seems to take to break it down. It is suggested that there may exist in the oil conducting particles which arrange themselves very much as iron filings do in a magnetic field; also that there may be some sort of convection which carries electrified oil from the electrodes into the space between them, finally breaking down the oil. He is at present continuing to investigate the subject more fully, and with his well known perseverance we have no doubt he will soon get at definite and reliable results. In order to see whether the time element can be extended, he intends to keep the oil flowing under pressure between the electrodes. To show how curious some of the results are, he found that under certain circumstances, potentials which perforated oil at a distance of three-eighths of an inch, at other times failed to puncture the same oil at a thirty-second of an inch. Such results certainly show that it is very necessary to investigate the subject more fully before relying too much on the small amount of knowledge we have up to the present time, regarding the insulating properties of oil. The law of resistance, which is such a simple one for continuous currents, appears to be a very complicated one when it concerns alternating currents, and especially so, apparently, when these alternating currents are of high frequency and exceedingly high potential. It would be a very valuable contribution to our knowledge of the subject of the insulating properties of oil if those who have the facilities will endeavor to discover its law—if there is any—before we make any mistakes by relying on our present insufficient knowledge of the subject.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At a regular meeting of the Wilkes-Barre (Pa.) Gas Company the following officers were chosen: Directors, W. L. Conyngham, A. H. McClintock, L. D. Shoemaker, J.W. Hollenback, John C. Phelps, Marcus Smith, A. A. Sterling. The Directors selected the following officers: President, W. L. Conyngham; Vice-President and Treasurer, John C. Phelps; Secretary and Superintendent, Marcus Smith. These are all re-elections, save in the case of Mr. McClintock, who succeeds his father.

We are indebted to an occasional correspondent for the following from Cincinnati, O., under date of May 4th: "At a meeting of the Directors of the Cincinnati Gas Company, held yesterday, Norman G. Kenan was elected Vice-President of that corporation, the office being created for General Hickenlooper and allowed to lapse when the General became President. This is a well-merited compliment to a deserving employee, necessitating a change in the by-laws, in strict accordance with the long-established and well-known policy of the Company to reward faithful performance of duty. Mr. Kenan entered the service of the Gas Company nearly 25 years ago, in the humble position of time-keeper; four years thereafter he was promoted to be clerk of the West End Works; and 12 years later was appointed Superintendent of that station. His success in that position was so marked that after the lapse of 3 years he was promoted to the responsible place of Engineer and Superintendent of the Company. He thus served until July, 1890, when another promotion was awarded him, in his appointment as assistant to the President. As before, he succeeded well in this trust, and now he has, as noted before, been elected Vice-President. Perhaps a word or two about the rewards that have been meted out by the Company to others of its subordinates who have done their duty well may not be uninteresting. The present Superintendent of the East End Station—Albert Hauck—entered the Company's service about 15 years ago and subsequently resigned to take a course in the Troy Polytechnic Institute. Graduating therefrom, he again was employed by the Company, eventually working his way up to his present responsible post. The Superintendent of the West End Station (Frank Foster) was originally a time keeper for the Company. William A. Miller, Superintendent of Manufacture, entered the Company's service as a bricklayer, but time and trial having proved his fitness, promotion came in consequence. Henry Felt who has entire charge of the Company's distribution system, when a mere stripling, joined the Company's forces as a lamplighter, and that he did not slight his opportunities, and that the Company did not overlook them, is best shown by pointing to his present rank. As was well remarked by the Cincinnati *Gazette* (to which source I am mainly indebted for the facts reported above) in commenting on this roster of the local Gas Company, 'Such a history of the leading spirits of an institution of which every citizen of Cincinnati should be justly proud, is an object lesson to the workers in the humbler walks of life, showing how, without influential friends or political influences, they may, by faithful performance of duty, win their way to the highest positions of trust and confidence.'"

We are indebted to Mr. F. H. Hambleton, Chief Engineer of the Consolidated Gas Company, of Baltimore, for the following particulars respecting the late Colonel Luther R. Smoot, Secretary of the Consolidated Gas Company, Baltimore, whose death was briefly noted in the Journal for the 2d inst.: Colonel Luther R. Smoot, Secretary of the Baltimore Consolidated Gas Company, who died at his home in this city (No. 1,416 Bolton street) on Thursday, April 28th, succumbed after an illness of about two weeks. He was born in Washington, D. C., in

1823, and was a graduate of Columbia College. He served in the Mexican war, and afterwards fought under the Confederate flag in the War of the Rebellion. After the cessation of the war he engaged in the banking business, representing the firm of Suter, Lee & Co., at Kansas City, Mo. Subsequently he came to Baltimore and engaged in the iron business, being associated with others in the development of the Buffalo Gap, Virginia, iron mines. In 1873 financial disaster overtook that enterprise, and the furnaces were shut down. Some time after the inception of the Consumers Gas Company, of Baltimore, Colonel Smoot was appointed Secretary, and when the Consolidated Company was formed, he was elected its Secretary, continuing as such until his death. His wife (a daughter of Mr. Charles D. Slingluff) survives him, as do two children. Deceased was a very methodical man, and a somewhat austere mien and gruff demeanor served poorly to conceal a nature that was kind and a practice that was generous.

THE Councils' Committee on Gas, Philadelphia, have referred the ordinance to reduce the Philadelphia gas rate to $1 per 1,000 cubic feet to the Committee on Works and Extensions. It is probable that that rate will be agreed upon.

WE are not telling any tale out of school now in saying that Mr. Frederick Riley Persons—our own Fred.—is a single-minded man no more. Miss Lettie Lucebia La Barre, one of Toledo's fairest daughters, is to be held accountable for this determination on Fred.'s part to change his views respecting the advantages of single blessedness, and the wedding bells rang out their dulcet tones in the La Barre-Persons marriage on the evening of the 11th inst. The marriage was celebrated at the home of the bride's parents, No. 2726, Monroe street, Toledo, amidst a throng of friends. Mr. Chas. Faben, Jr., was the man who "gave Fred. away," and he did it nobly. We have an idea that the region of the Venice of America—otherwise known as the St. Clair Lake and connecting waters, "up Detroit way"—this week will be honored by a glimpse of the happy pair. In any event, no matter where their future path shall lead them, may happiness and good luck be their portion.

MESSRS. JOSHUA GIVEN, W. H. Hoar and James Wall, a special committee of the Council of Elgin, Ills., appointed to consider the matter of an extension to or an increase in the city's arc lighting plant, advertise that sealed proposals will be received up to 8 P.M., of June 24th, for the following apparatus: One horizontal, tubular steel boiler, and one 50 or two 35 light, low tension dynamos, "for an extension of city lighting plant, in accordance with specifications on file in the City Clerk's office."

IF we mistake not, the Elgin municipal plant, when the same was installed two or three years ago, was guaranteed to be equal to all the lighting requirements of the city "for many years." Perhaps "three" means "many" in Elgin—three is greater than two, or one, anyway.

WE are in receipt of a handsome new catalogue, printed at the instance of the National Gas Light and Fuel Company, of Chicago. It is an elegant sample of cut and type printing, and the descriptive matter is well compiled. In fact, its lines suggest the handiwork of Manager Fred. Shelton—at least in great part. Of course, the catalogue is designed to give prominence to the National Gas Company's specialties.

MR. GEORGE L. WOODS has been appointed Assistant Superintendent and Manager of Construction by the Standard Gas Company, of this city. Mr. Woods looks to have a good future before him in the gas business, which is not to be wondered at when it is known that he graduated from what must now be known as the Young-Baxter school of gas engineering. The graduates from that school seem to be in demand—some three or four from it have secured good places in the industry during the past year—and justly so. Mr. Woods was Assistant Engineer, under Mr. Baxter, at Detroit, and afterwards was in charge, as Engineer and Superintendent, at Little Rock, Ark., from whence he comes to New York. He is a man of deeds, not words, and as such will find plenty to occupy him at the Standard Company's works.

IN the meantime the Little Rock Company is puzzling itself over selecting a successor who will fit the vacancy occasioned by the resignation of Mr. Woods.

EARLY this month the City Council, Richmond, Va., discussed the resolution, adopted previously by the Board of Alderman, appropriating the sum of $25,000 for the purchase and installation of an auxiliary water gas plant. Superintendent Adams favored the proposition, in a speech following an invitation to address the Council on the subject, as did Messrs. Glover, Guigon and Thomas. Mr. Grimes was very pronounced in his opposition, as were Messrs. Diacont, Curtis and Houston. The result was that the Council rejected the proposition, the vote standing: Aye, 9; nay, 15.

AT the annual meeting of the Bristol (R. I.) Gas Light Company, the following Directors were chosen: Hon. Robert S. Franklin, Col. A. P. Sherman and Messrs. J. C. Swan, J. Howard Manchester and Hezekiah W. Church. At the organization meeting the following officers were named: President, Hon. R. S. Franklin; Secretary, Treasurer and Superintendent, J. Howard Manchester. The Company is in excellent shape.

SOME light on a dark subject was recently shed at a session of the Committee on Light of the Richmond (Va.) gas works. Superintendent Adams, with his usual eye to business, noticed on several occasions that the returns of gas consumed in the building on Seventh street, occupied as a drill room by the Colored Battalion, were excessive. A little investigation disclosed the fact that the colored troops were in the habit of "trying on" several new cake walk steps in the interim of the drill evenings, and as the gas is furnished free for drill room purposes, the cost of the drilling and the "walking" was found to be rather steep. The upshot of the matter was that, on motion of Mr. Seay, the commandant of the offending battalion was notified that gas consumed in the hall, on nights other than those set apart for drilling, would have to be paid for, under the penalty of the forfeiture of the right to obtain any free gas.

WRITING of the Richmond Council Light Committee causes us to say that by its direction, a contract for the supply of 16,000 tons of gas coal, to be called for during the twelvemonth ending May 1, 1893, was awarded to the Chesapeake and Ohio Railroad Company, "at different prices, according to the *quality* of the coal required." Pretty elastic contract, that; and one that should be very easy of fulfilment—by both parties to it.

THE proprietors of the Bergen County Gas Light Company, of Englewood, N. J., have decided on making important plant betterments, and have, as a beginning, awarded contracts for the construction and equipment of a handsome new retort house to Capt. Wm. Henry White, of this city. The house is to be of brick, with iron roof, the plans showing the dimensions to be 32 feet in length, by 27 feet in width, by 17 feet 3 inches in height. Two benches of 5's have been arranged for, and the work is to be finished by September 1st.

IN our issue for last week we printed an item to the effect that Mr. J. E. Shatzer had leased the works of the Dover (Del.) Gas Light Company, but coupled with it the intimation that our informant might have been mistaken. We are pleased to say that the intimation had more of truth than the "item," forwe are now in receipt of a positive notice from Mr. A. B. Richardson, President of the Company, that the works have not been leased, and are under direct control of those who some years ago took the plant over, when its value was almost nothing, and who by patience, skill and liberality have put the Company on a solid financial basis.

SOME days ago the reporter of a local Brooklyn newspaper called upon Mr. Rossiter, the clever and urbane Secretary of the Fulton-Municipal Gas Company, to interview him respecting the influence on the Company's business of the operations of the local Edison Incandescent Electric Light Company. Mr. Rossiter, in substance, said that they were not concerned greatly over the Edison Company's promises to maintain a better lighting service, at a decidedly reduced rate over that formerly charged. He knew that, equal volumes of light considered, gas was vastly cheaper than incandescent electric lighting, and it was a matter of record on their books that the Fulton-Municipal Company's business was gaining rapidly. He called attention to the rapidity with which gas was being adopted as a means of cooking and heating, and concluded by remarking that the outlook was in every respect satisfactory.

MR. FREDERICK H. SHELTON, Secretary of The Gas Club, of Chicago, more than likely through the kindly offices of Mr. L. D. Heusner, Passenger Agent at Chicago for the Michigan Central Railroad, has arranged to bring on the Chicago delegation to the Western Association meeting in right royal style, and at the one and one-third fare rate, too, as will be seen from the following circular, issued by Mr. Shelton, under date of the 5th inst.:

" * * * , Dear Sir: I am pleased to announce that the Central Traffic Association have granted a rate of one fare and one-third ($10.35) from Chicago to Detroit and return, for the occasion of the meeting of the Western Gas Association, to be held in Detroit, May 18th, 19th and 20th. To make the trip more enjoyable we would like to make up a party to go together from here in a special car, to be attached to the North Shore Limited of the Michigan Central, leaving at 12:20, noon, May 17th, arriving in Detroit at 7:20 the same evening. With this end in view please advise Mr. L. D. Heusner (by inclosed postal card) or myself, if you will join the party to go on this train, in order that suitable arrangements may be made. The tickets at this reduced rate will be good on any of the other trains via this route, so that those who are unable to go on the midnight train can leave Chicago at 3:10 P.M., arriving in Detroit at 10:45 P.M., or at 9:20 P.M., and arrive in Detroit at 7:10 the next morning. It is hoped you can join the party as outlined above, which will probably be large enough to have a special car reserved for it.—F. H. SHELTON, Secy."

EARLY this month the employees of the Beaver Valley Electric Light Company, of Beaver Falls, Pa., pursued a novel method in attempting to collect from their employers money claimed to be due them on account of wages. They asserted that 6 weeks unpaid labor was sufficient cause to justify them in resorting to extreme measures, and the latter took the shape of an entrance into the generating plant, where, on a given signal, the ringleaders shut off the current from the town's lighting circuit, and great confusion was the result. Mr. Critchlow, who is a Burgess of the district, sent a force of officers to the point of disturbance, and at the same time several of the Company's Directors appeared. On the assurance that the money would be forthcoming within 48 hours, the normal condition of affairs was restored.

THE wide awake proprietors of the Nashua (N. H.) Light, Heat and Power Company are not satisfied to let well enough alone, in the matter of the number of gas cookers already installed in their beautiful city, but are moving briskly in a businesslike way to increase the output of those useful, economical and labor-saving appliances. They have engaged Miss Daniel, a graduate of the Boston Cooking School, and late Principal of the Cincinnati Cooking School, to give a series of four lectures on gas cookery, in the well appointed reception room of the local Beasom Hall. The lectures, which are to be started at 2:30 P.M. of each afternoon, were arranged for the following dates: Wednesday, May 11; Saturday, May 14; Wednesday, May 18; Saturday, May 21. The "programme" of the respective lectures is as follows—notice how pretily it is arranged to sound the complete gamut of the different clangings of the "bell to table:" Wednesday, May 11.—*Breakfast.*—Baked apples with wheat; halibut steak, *a la Flamand;* quick Parker House rolls; coffee. Saturday, May 14.—*Lunch.*—Cream of cauliflower; filet of halibut, *a la poulette;* cream sauce; potato balls; luncheon muffins. Wednesday, May 18.—*Dinner.*—Puree of peas; roast beef; brown potatoes; tomato salad, *sauce Francaise;* wigwam pudding. Saturday, May 21.—*Supper.*—Broiled beefsteak; soft-bath gingerbread; finger biscuit; baked apple sauce; cocoa. Miss Daniel, of course, will cook all these viands on a gas range, in full view of the audience; nor do we put it any too strong when we say that she is very womanly, and can talk fluently—volubly, of course, goes without saying. Admission is by ticket only, which can be obtained by any respectable person on application to the Company. Each visitor is presented with a neat paper bound memorandum sheet, and the programme or *menu* card, which is handsomely printed on a 4-sheet, stiff, colored bristol board, also conveys the intimation that guests are to "bring pencil and spoon."

WE had, on Friday last, a brief intimation from Nashua that the initial lecture (Wednesday last) was a pronounced success. The "best folks" turned out in force, and the fair ones all agreed that they had "a lovely time; so interesting."

"W. T. S." is hereby informed that the interest for the last half on the Eastport (Me.) Gas and Electric Light Company's bonds was due and payable on the 2d inst.

SOME time ago we noted that the proprietors of the Bowling Green (Ky.) Gas Light Company had offered for competition a gold watch, to be awarded to the housekeeper who should, within a specified time, have sent to the Company the best specimen of a white cake, home made, and baked in a gas heated oven. It is not necessary to here repeat the conditions of the contest. Suffice it to say that the contestants numbered a bakers' dozen, and the jury awarded the prize to Mrs. John Carter, wife of a well-known engineer on the Louisville & Nashville Railroad. It is worthy of note that the prize winner only had an experince covering four months in the use of or manipulation of a gas range.

THE franchise, granted in 1886 by the City Council of Kansas City, Mo., to Henry McGurren and Michael Ryan, and others of Chicago, for the operation of a gas works in Kansas City, for a period of 50 years, from Feb. 1, 1886, having been declared invalid, the incorporators have entered a protest against what they term "an interference with our vested rights." As the "Company" has taken no step to carry out the purpose for which it was formed some six years ago, it is somewhat difficult to determine where the "vested rights" come in. The days of "vest pocket" ordinances are numbered, even in Kansas City.

AT the annual meeting of the Wilmington (N. C.) Gas Light Company the following officers were chosen: Directors, Dr. A. J. De Rossett and Messrs. D. MaRae, E. S. Martin, J. F. Divine, G. W. Kidder, Geo. R. French, and G. H. Smith. The Directors subsequently perfected the following organization: President, E. S. Martin; Secretary and Treasurer, R. J. Jones: Superintendent, J. W. Reilly. The business of the Company during the year was satisfactory to the shareholders.

THE suit of Hannah T. Jackson against the Wissahickon Electric Light Company, of Philadelphia, Pa., was recently tried before Judge Read and a jury in the local Court of Common Pleas. Plaintiff sued for personal injuries in the sum of $10,000, received on November 10, 1890, while driving through Fairmount Park. It appears from the evidence that some of defendant's wires, having fallen to the ground, came in contact with the animals drawing the plaintiff's carriage, causing them to take fright and run away. Plaintiff was thrown to the ground and severely injured. She urged gross negligence on the part of defendant, and the jury evidently agreed with her, in that they awarded her a verdict for $5,000.

AN echo from the disastrous explosion of some months ago that wrecked the old electric lighting station of the Louisville (Ky.) Gas Light Company, is heard in the recent reported proceedings of the Louisville Court of Common Pleas. One of the consequences of the explosion was the wrecking of the adjoining drygoods shop of Messrs. Kauffman & Straus, several of whose employees were injured. One of these (a Miss Hettie Ennis) brought suit against the Gas Company, placing damages at $10,000. The case was on the calendar for trial on the 3d inst., but before it was called the attorneys announced that a compromise had been reached.

THE Committee on Manufactures, Massachusetts Legislature, report that no legislation or further inquiry is necessary respecting the gas supply of Boston. Also, that it is inexpedient to regulate the price of gas in that city. Now, then, Mr. Addicks seems to have made good his boast that he could *convince* the law makers of the Bay State that everything was all right.

MESSRS. R. D. WOOD & Co., will this summer add a third lift to each of the gasholders at the supply station, 9th and Diamond streets, Philadelphia, Pa.

WE regret to report the death of Mr. J. G. Salva, who passed away, on the morning of May 8th, at his residence, No. 56 Clark street, Brooklyn. The cause of his death was Brights disease, and his illness covered a long period. Mr. Salva was well-known among the Eastern gas makers as a broker in gas coals, and was also well-liked. He was about 53 years of age. Interment was made at Baltimore, on Tuesday last.

AT the annual meeting of the Newton (N. J.) Gas Light Company the following Directors were chosen: Alfred F. Fellows, Francis J. Swayze, John W. Lane, Wallace Myers, Samuel C. Dunn, Oliver D. Reeves and Rutherford Tuttle.

GENERAL WILLIAM WELLS, a prominent member of the Board of Directors of the Burlington (Vt.) Gas Company is dead. The funeral services were celebrated at Burlington, on the 3d inst. During the ceremonies business in the city was generally suspended.

THE Consumers Gas Company of Toronto, Canada, will construct a new gasholder on the Bathurst street site.

THE New York offices of the Fort Wayne Electric Company have been removed to Nos. 42 and 44 Broad street, where the genial and businesslike Mr. H. C. Adams will be pleased to receive the Company's clients.

THE 12th annual meeting of the American Water Works Association will be held in this city, beginning to-morrow, and closing on Saturday. The headquarters and meeting room are named for the Metropolitan Hotel, corner of Broadway and Prince street. Mr. J. M. Diven, of Elmira, N. Y., will preside, and the Secretary's desk will be manned by Mr. J. H. Decker, who will be pleasantly identified by the gas fraternity as the engineer who so capably managed the gas and water supply of the city of Hannibal, Mo., and who was also at one time permanently identified with the Western Gas Association when that giant of to day was the youngster of more than a decade ago. The outing-time programme is a most elaborate one, and the paper list is brimful of promising themes.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

A Letter from Mr. Allen to an Inquirer.

POUGHKEEPSIE, N. Y., April 15th, 1892.

To the Editor AMERICAN GAS LIGHT JOURNAL:

The following correspondence between a gas engineer and myself explains itself:

* * *—Dear Sir: Your favor was duly received, but sickness has prevented my replying until now; and still I must be very brief. I previously wrote you at considerable length, and gave you what I believed to be abundant proof of my statement, in relation to the production of 20,000 and 30,000 cubic feet of high candle gas per ton of coal, and its equivalent from oil and its products, and the purification of 65,000 to 113,000 cubic feet per bushel of ordinary slacked lime, under the Allen-Harris process. But you reply, "I cannot yet understand how the results you claim can be obtained." I cannot be surprised at this want of confidence in my statements, considering how far short you have come of such results under the Lowe process and others which you have been accustomed to use. But you have not, and you cannot show that the results which I claim exceed, or even nearly approach the practical requirements of science and chemistry in the production and purification of gas from the weight and measure of materials ordinarily used. The most astonishing fact to me is that gas engineers, who have position, prestige and ability, can be willing to say, "I can't believe your statements," instead of looking to see what science and chemistry require in the line of their calling, and then making all possible efforts to accomplish such results.

You must admit that if my statements are true (and that they are will yet be fully demonstrated), Allen and Harris have made a great advance in the manufacture of gas, even under very unfavorable circumstances, beyond the point that has ever before been reached by any one else under any other process.

But you say, "I cannot yet understand how the results you claim can be obtained." I reply, that expert gas chemists have demonstrated that a ton of bituminous coal contains over 44,000 cubic feet of non-luminant gases, and 55,000 cubic feet of luminant gases. Here is a possible 99,000 cubic feet per ton, of which over 50 per cent. are luminants.

It is well known that the best illuminating gas does not contain over 7 per cent. of luminants, and the highest average yield heretofore has been 10,500 cubic feet of 17-candle gas per ton. Again, it is well known that a ton of bituminous coal will yield by practical working 80 gallons of oil (which will produce more candle power than mineral oil), and that mineral oil will yield 80 feet of 70-candle gas per gallon. This will yield 448,000 candles per ton of coal. With 7 per cent. of luminants for 22-candle gas, we here have at hand materials for 64,000 cubic feet of 22-candle gas per ton, or its equivalent in oil. These results are required by science and chemistry. But the great gas fraternity have been satisfied with 10,500 cubic feet of 15 to 17 candles per ton. Is there any other great industry in the world in which science and chemistry have been ignored to such an extent as in the manufacture of gas? I here find a very wide field from which the results which I claim "can be obtained."

Again, under the Allen-Harris process of "continuous, uniform, high, external heats" of 1,500° F. and upwards, and with a full supply of *hot* water gas direct from the generator (no intermediate holder being used) during the process of manufacture of gas, ammonia, carbonic acid, bisulphide of carbon, etc., *cannot be formed*. Naphthaline and incrustations in the retorts *cannot be deposited*, and no gas material will be wasted in smoke and soot, or the production (as is usual) of 12 or 15 gallons of tar per ton of coal; and little or no purification of the gas will be required.

Great value has been placed upon the residuals made, but the much greater value of the gas which might have been obtained instead thereof has been almost entirely ignored. I believe that upon a more thorough investigation of the facts in the case you will become convinced that the results claimed by me have been obtained by us, and that still better results are perfectly feasible under our late improvements.

I am well aware that you and others, whose time and energies are almost entirely absorbed in the management of large gas plants, cannot devote the time required for these investigations and necessary experiments; but I think that the facts which I present, after 15 years of close application and practical experience in this line, are entitled to consideration. However, I can afford to wait for coming events.

Yours truly, A. L. ALLEN.

A Study of "Study No. I."

NEW YORK, May, 11, 1892.

To the Editor of the AMERICAN GAS LIGHT JOURNAL:

It could hardly be expected that such a piece of misinformation as the communication of "W. E. F.," in the JOURNAL of April 25, would pass unnoticed. Lest some should be misled a *few* of the errors might be pointed out with profit.

The antique method of writing the "reactions," coupled with the sublime disregard of chemical laws, as now known, leads to the suspicion that the aforementioned "study" must be of alchemistic origin, long before the industry of gas making was known. The reason "W. E. F." has never seen said diagram "in any issue of the JOURNAL, nor in any of the ordinary books on gas making" is patent.

Mixing slaked lime and copperas we have the following reactions:

$$\underset{\text{Copperas.}}{FeSO_4} + \underset{\text{Slaked lime.}}{Ca(OH)_2} = \underset{\text{Ferrous oxide.}}{Fe(OH)_2} + \underset{\text{Sulphate of lime.}}{CaSO_4}$$

$$4Fe(OH)_2 + O_2 + 2H_2O = 2FeO_2H_2 \ldots\ldots\ldots (I.)$$

making hydrated oxide of iron the active constituent of iron sponge, whether made with lime or by rusting iron chips in the air with sawdust and water, thus:

$$4Fe + 6H_2O + 3O_2 = 2Fe_2O_2H_2 \ldots\ldots\ldots (II.)$$

That the latter is the preferable method, both as to cheapness and efficiency, no one of experience doubts. That the sulphate of lime formed by the first method changes by contact with impure gas, is proved neither by theory nor by practice. Chemically, we know that sulphate of lime, gypsum, plaster of paris, or call it what you will, is not easily affected. Further, the experienced gas engineer knows that carbonic acid (CO_2) is not removed from the gas by lime sponge (I.) or any other kind of sponge, and without its removal carbonate of lime could hardly be formed. He also knows that practically no ammonia is present in the purified gas where sponge is used, made according to equation (II.)

(See Report Mass. State Gas Inspector, 1892.)

All of which goes to prove that sulphate of lime is useless as a purifying agent, clogs the sponge, and causes it to cake in the boxes. So good an authority as Prof. Chandler says, "The German gas engineers have found that the mixture owes its efficacy entirely to the oxide of iron which it contains, and that the sulphate and hydrate of lime present do not take any appreciable part in the purification. All the Liverpool gas, much, if not all the London gas, and that of most of the German cities, is now purified either by iron ore or one of the artificial oxides of iron."

An inspection of the following familiar equation shows that only two-thirds of the sulphur unites with the iron, notwithstanding that wonderful diagram:

$$Fe_2O_3 + 3\,H_2S = 2\,FeS + S + 3\,H_2O.$$

Not to take too much of your valuable space, let me first glance at the second part of the diagram; for the thing seems to be "open to conviction" in every line.

The air of Massachusetts must be marvellously potent to break up carbonate of lime, even if it were present in the foul oxide, and play such havoc with ammonia salts; but its most remarkable feat is to oxidize plain, dirty, cold sulphur up to sulphuric acid. The manufacturers of such acid in that State have evidently gone to much unnecessary trouble and expense to make so common a product. C.

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MONDAY, MAY 16, 1892.

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Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

MAY 16.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	115¼	115½
Central	500,000	50	—	90
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	150	155
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	135	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	40	45
Preferred	5,000,000	100	91	93
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	106	110
Citizens	1,200,000	20	106	107
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	129	—
" Bonds	300,000		102	—
Peoples	1,000,000	10	85	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	102	—
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	139	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	123	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	89	89½
2d " " "	3,000,000	1000	78	78½
Bay State Gas Co.—				
Stock	5,000,000	50	60¾	61¼
Income Bonds	2,000,000	1000	°6	8
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Company	25,000,000	100	80⅝	80¾
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	90½	90⅞
Equitable Gas & Fuel Co, Chicago, Bonds	2,000,000	1000	—	97½
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	102	—
2d "	2,500,000	1000	101½	—
Consumers Gas Light Co., Jersey City	2,000,000	100	17	22
Bonds	600,000	1000	78	82
Cincinnati G. & C. Co.	7,000,000	100	—	200
Consumers Toronto	1,000,000	50	180	185
Central, S. F., Cal			90	—
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	54¾	55
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	180	200
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	21¼	21½
Preferred "	2,500,000	100	60½	61
Bonds	9,034,400	1000	82½	83
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	40	—
" Bonds	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal			34¾	35¼
Peoples, Jersey City		—	115	125
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	99	100
Syracuse, N. Y	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal	10,000,000	100	63	63½
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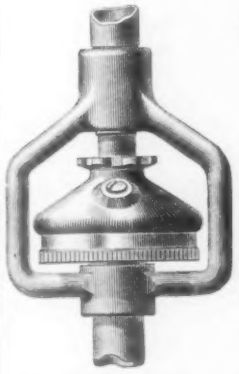

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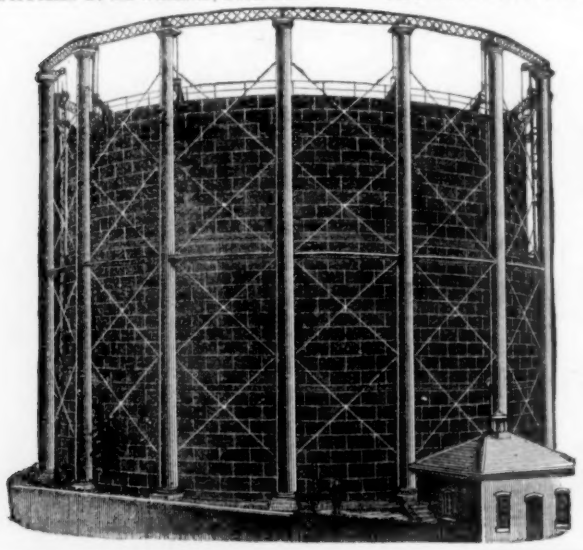

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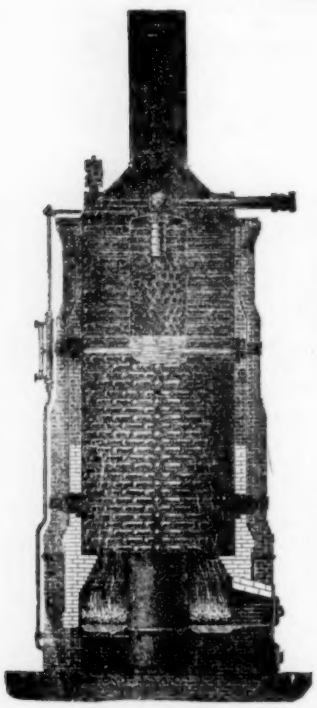

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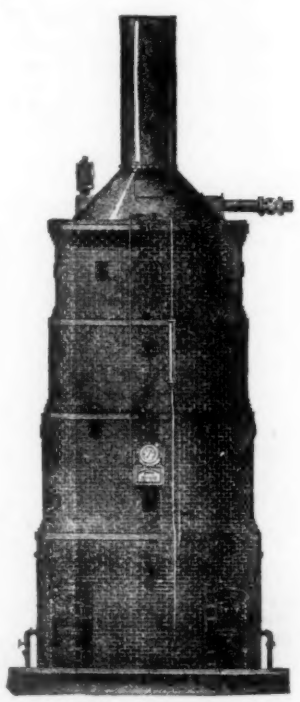

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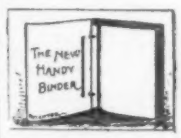

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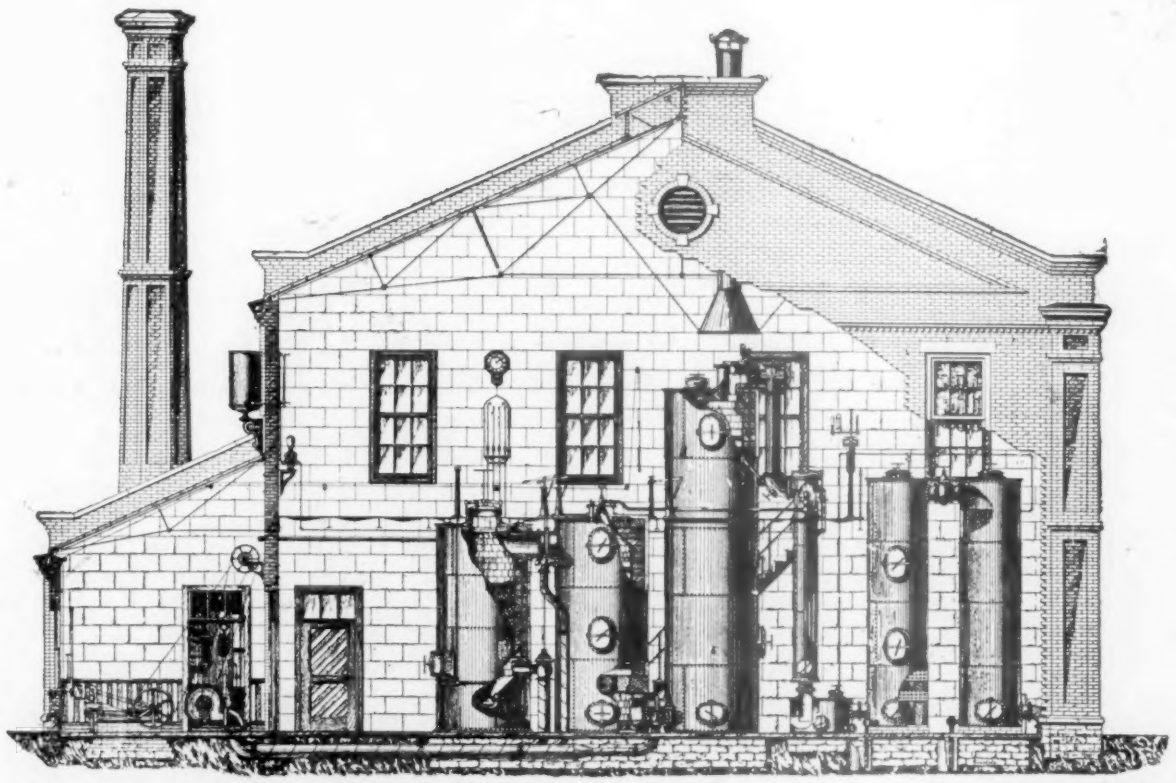

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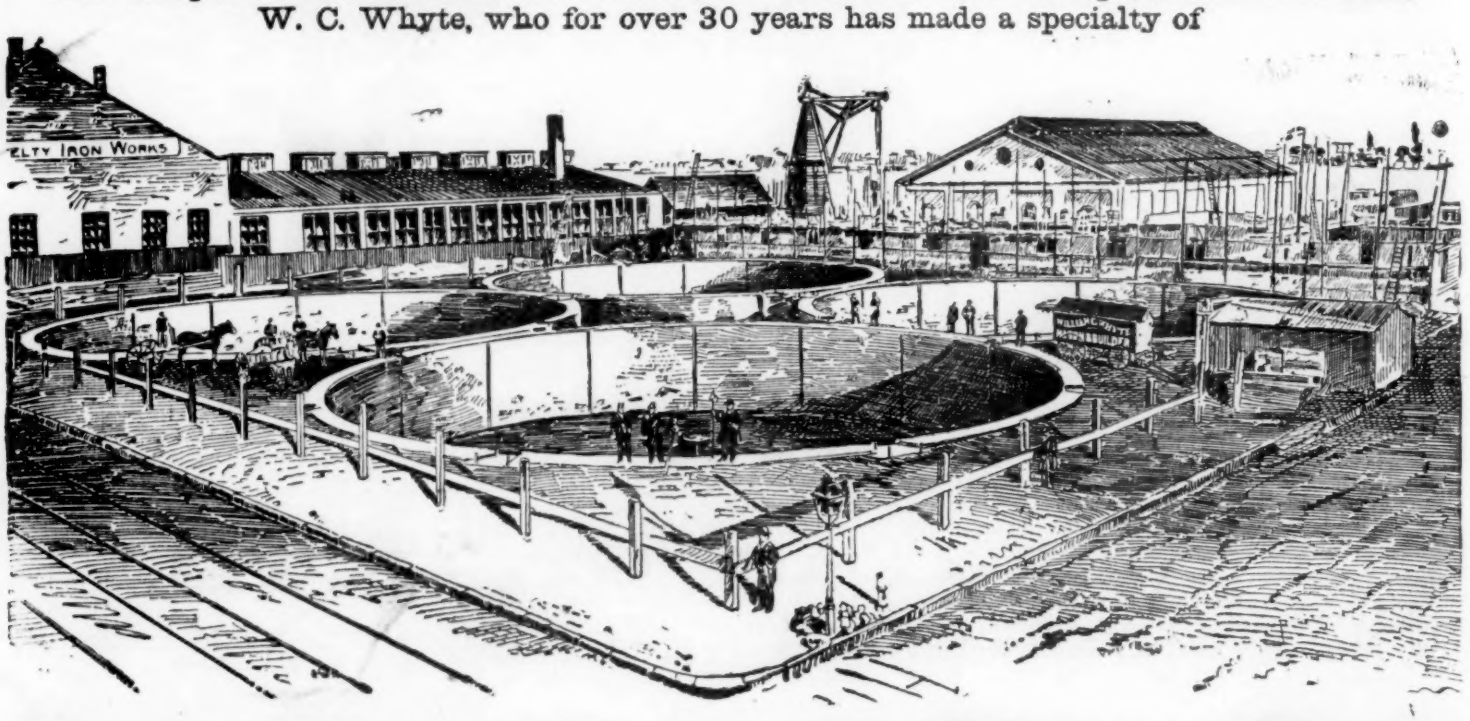

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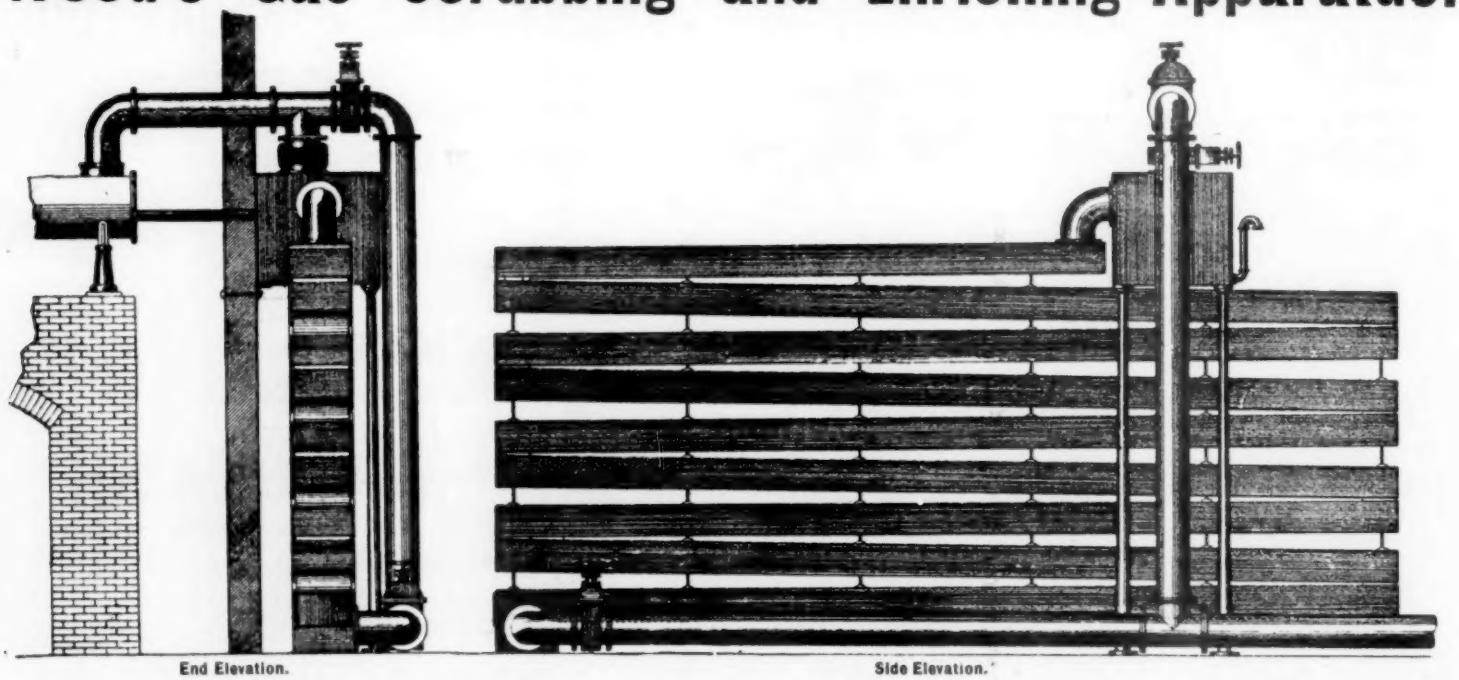

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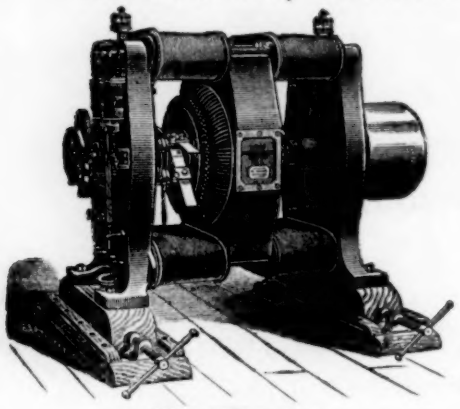

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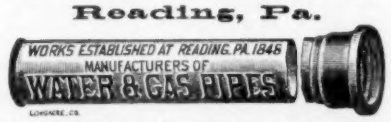

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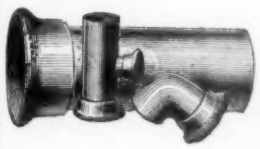

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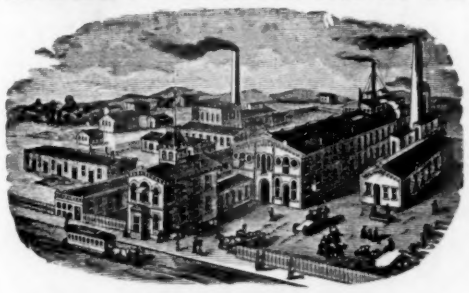

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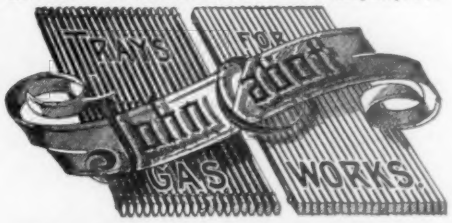

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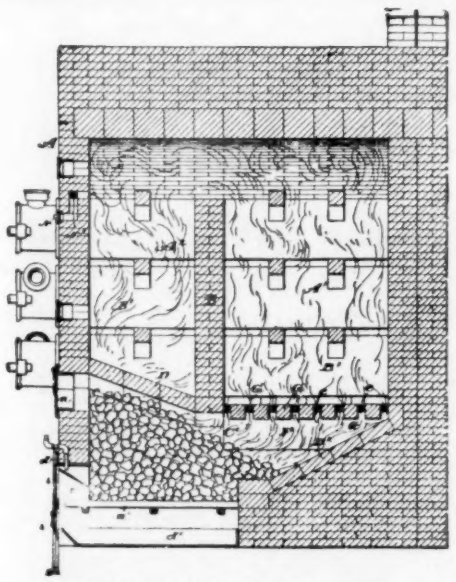

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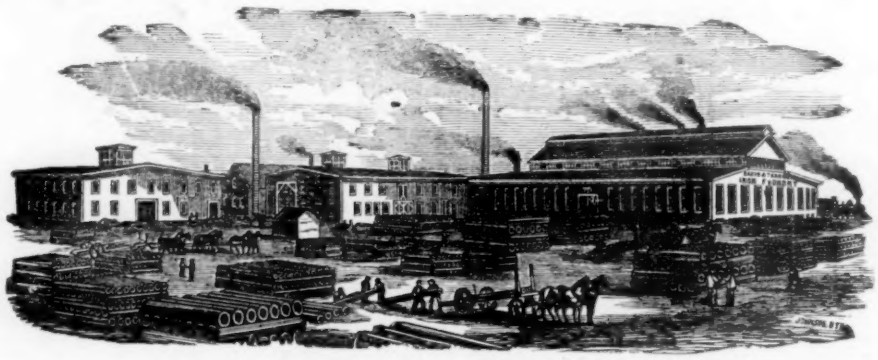

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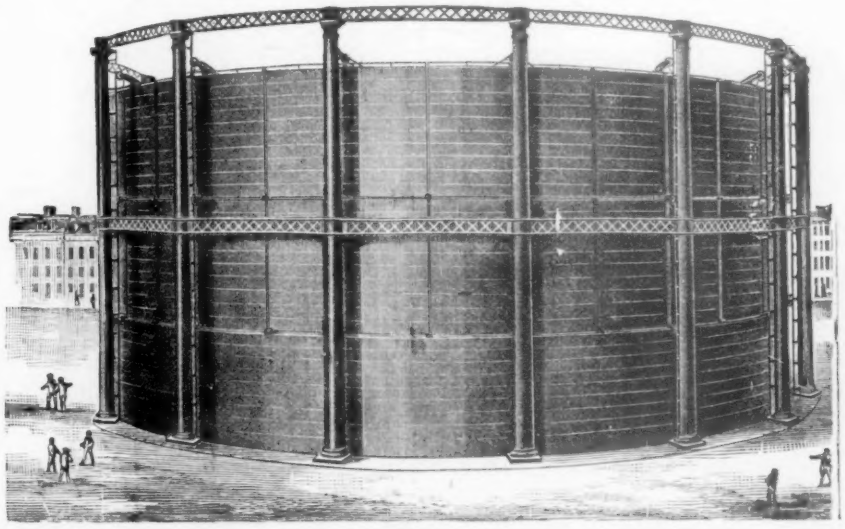

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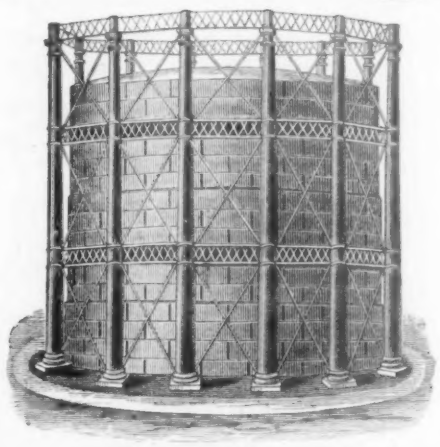

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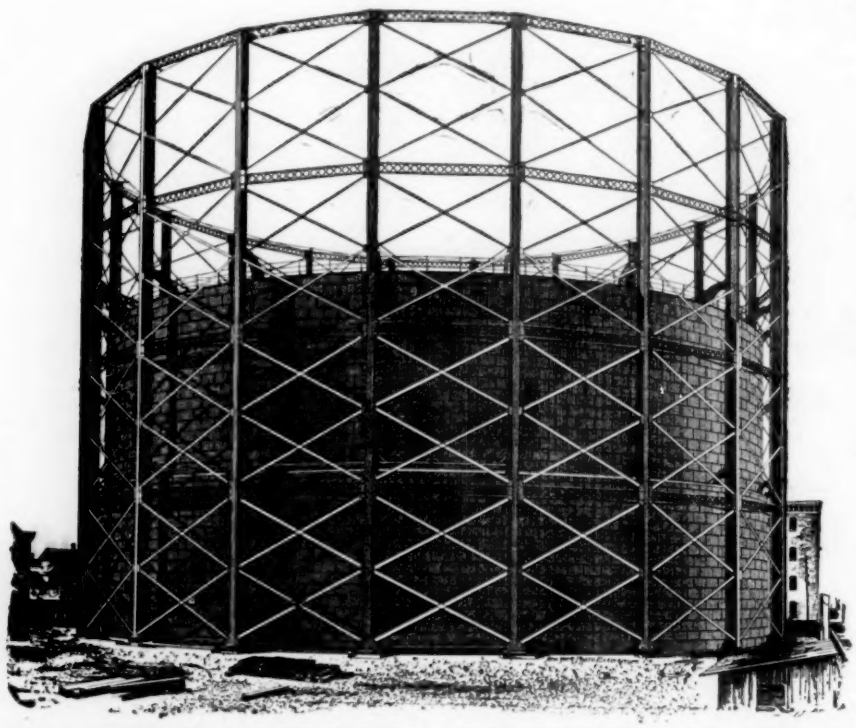

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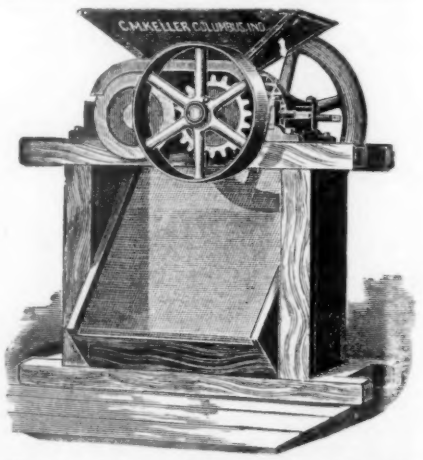

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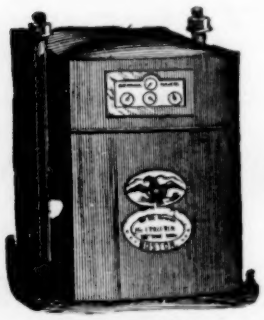

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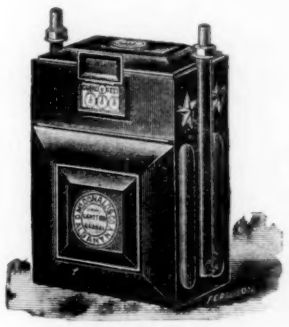

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